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Contents.

	PAGE
A Review of the Foundry Industry	15
The Foundry Industry Month by Month	17
Commercial Developments in the Light-Castings Industry	18
The Pig-Iron Trade in 1931	19
The British Steel Foundry Industry in 1931	20
Foundry Research in 1931	21
Recent Developments in the Textile Engineering Industry, with Special Reference to the Foundry Section	23
Recent Developments in the Automobile Foundry Industry	24
Recent Developments and Business Conditions in the U.S.A. Foundry Industry	25
The Foundry Industry in Czecho-Slovakia in the Year 1931	26
Recent Developments in Railway Foundry Practice	27
The Italian Steel Foundry Industry in 1931	29
The Non-Ferrous Metals in 1931	30
Recent Developments in Aluminium Founding	31
Developments in Marine Engineering Foundrywork	33
Agricultural Engineering in 1931	34
Difficulties in Modern Jobbing Foundry Practice	35
American Business Forecast	35
The Foundry Equipment Industry in 1931	36
The Belgian Foundry Industry in 1931	37
The Malleable Castings Industry in 1931	37
The Work of the Institute of British Foundrymen in 1931	38
Recent Developments in the Non-Ferrous Foundry Industry	40
Cast Iron from Ore to Mould	44
This Week's News in Brief	48
Raw Material Markets	50

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES' EQUIPMENT AND SUPPLIES ASSOCIATION.

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The Registered Office and Laboratories of the B.C.I.R.A. are at:—
24, ST. PAUL'S SQUARE, BIRMINGHAM.
Telephone: Central 1885. Telegrams: CIRA.
The B.C.I.R.A. Scottish Laboratories are:—
Foundry Technical Institute, Meek's Road, Falkirk (*Telephone 332*).

Forthcoming Events.

JANUARY 19.

Sheffield Metallurgical Association:—Ordinary meeting. "Pressed Steel in the Automobile Industry," Paper by J. C. Arrowsmith, M.Met.

Institution of Welding Engineers:—Ordinary meeting in London. "Nickel and its Non-Ferrous Alloys, with Special Reference to Welding," Paper by J. McNeil.

JANUARY 21.

Co-ordinating Committee:—Joint meeting at Birmingham. "Electric Welding of Non-Ferrous Alloys," Paper by A. Burstall, D.Sc.

Institute of British Foundrymen.

JANUARY 16.

Scottish Branch:—Ordinary meeting at Glasgow. "Sand Testing in the Foundry," Paper by W. Y. Buchanan.

JANUARY 21.

London Branch:—Ordinary meeting. "The Practical Working of Rotary Pulverised-Fuel-Fired Melting Furnaces," Paper by W. Scott.

A Review of the Foundry Industry.

IN the corresponding article to this which we wrote last year we finished on the note that we envisaged "no boom." Little did we expect that Great Britain would depart from the gold standard, and that there would be a complete metamorphosis of the political situation. It would have been thought that such outstanding events would have wrought great changes in the trade of the country. Yet it cannot be said that, beyond creating a feeling of optimism, any real benefit has yet been felt by the industry as a whole. Thus trade can be stated to have been bad in all sections, and probably a decrease of 15 per cent. represents the general level.

The Steel Foundry Industry.

The review of the steel industry, written by Mr. Deschamps, discloses the appalling situation that the steel foundry industry is probably operating at less than 50 per cent. capacity. Unlike Mr. Wells, Mr. Deschamps does not believe that, given normal trading conditions, there is any great excess of foundry capacity over probable consumption. The importation of steel castings, whilst being only 10 per cent. of domestic output, is serious, because it tends to lower internal prices, which are now no longer remunerative. Last year, on the invitation of Mr. Wells, we were asked to state our views for the rehabilitation of the steel foundry industry. We have re-read them and have nothing to add or withdraw. They apply with greater force to-day than ever. In a nationally-unified system of costing the key to the misfortunes will be found. We agree with our contributor that the time is ripe for revised specifications of a more severe character.

Non-Ferrous Activities.

The feature of the year has been the continued fall in the prices of the raw materials and the contraction of business. The non-ferrous trade is dependent on marine engineering and public works contracts to a larger extent than is generally realised, and both these sources have been drying up. Whilst it seems extraordinary that we should deplore the provision of cheap raw materials for this section of the foundry industry, yet we have noted that trade is better for this section when prices of raw materials are either stabilised or rising. There seems to be some chance of the bottom of the market for the majority of the non-ferrous metals being reached in the near future. This will react on the others, and we envisage distinctly improved trading conditions. We have never been enthusiastic as to the desirability of development departments of the various research organisations. So long as we possess metallurgists of the calibre of Mr. Dews they are unnecessary. His article has "pulled out," for the benefit of our readers, all the "plums" of the non-ferrous research "pudding." His pointer on the use of berylium is indeed illuminating and worth following up by every non-ferrous foundry executive. We believe that the inroads made by the manufacturers of milk and gum products on the preserves of the foundry industry have been stemmed. Their "life" under varying conditions is doubtful, whilst the colours of one large group are distinctly drab. Collaboration with the enamelling industry will take the battle into the enemies camp.

Malleable Foundries.

Mr. Bagshawe in his article refers to intense price cutting within this industry, and attributes this state of affairs to current economic conditions. We have envisaged these conditions for some time past, but have based our views on a struggle between the old-fashioned concerns, whose plant and property are virtually worth zero and whose methods are empirical, and the modern shops possessing every mechanical aid, supplemented by a real knowledge of their processes and products. The former, having such small overheads, can quote lower prices, and whilst the latter, because of their better manufacturing methods, can, of course, follow suit, the handicap of the old-fashioned manufacturer becomes greater with the passing of time, as he is less adaptable. A word of warning seems necessary to certain manufacturers of malleable as to the potentialities of the short-anneal material. If by any chance they lower the general level of the properties of malleable iron, they will find that the grey iron people will be tempted to heat-treat their material to induce a modicum of elasticity and become competitive. We counsel this industry to maintain quality at all cost, for herein lies a vast and expanding market.

Ironfounding in General.

Ironfounders divide themselves into two classes: the "go-aheads" and the "stick-in-the-muds." Size has no influence, for some of the very smallest are definitely progressive, whilst a few of the very largest still possess equipment which was modern forty or fifty years ago. Thus, whilst business in general has been really bad, yet those possessing modern business notions, coupled with up-to-date plant, have been reasonably employed.

Exports of iron castings have been well maintained, but at a sacrifice of 15 per cent. in price, whilst imports are down 33 per cent. in

volume and 42 per cent. in value. Whilst the average export price receded from £30 to £20, the import value decreased from £21 to £20 per ton. For the trade in general we estimate that the reduction in business has been of the order of 15 per cent.

Pipe Founding.

Last year we hinted of a new development being imminent. We referred to the creation of the sand-spun pipe foundry at Staveley. This is now well in production, and bids well to be an outstanding success. The centrifugal plant at Stanton has undergone various changes and is now producing a longer pipe, whilst the range of diameters has been extended. The export side of the industry has been extremely badly hit. It has lost virtually a third of its tonnage, but prices have been maintained. This type of industry cannot benefit immediately from altered trading conditions, as public works authorities are inherently somewhat sluggish in business movements owing to committee sanctions and the like. The spring should see some improvement in the export market unless there is some further international upheaval of a retarding character.

The Light-Castings Industry.

The industry has been caught in the vortex of the depression, and exports have dwindled by some 20 per cent. A pleasing feature is that the value of the exports in November was £69,343 for 1,518 tons, whereas in 1930 virtually the same amount, £69,448, was received for 1,606 tons. The light-castings trade was immediately affected by the departure from the gold standard and the conditions which followed. There was a real increase in business both in Scotland and England. Moreover a certain amount of dumping was experienced. The increased business, though representing nothing in the nature of a boom, continued until Christmas, when it was found necessary—at least in Scotland—to extend the holiday period. The foundries in the south are distinctly better placed, and one making baths has several months' work still in sight. No doubt a really heavy snow storm would be welcomed by the gutter manufacturers, as that can be relied upon to find about three weeks' work. This past year has seen the strengthening of the British Ironfounder's Association, and it can be stated without fear of contradiction that never was there a more urgent need for it than now. Sir Gervais Rentoul, its President, has dealt with the problem of price cutting from truly basic considerations, and his arguments for co-operation are well worth consideration by all other sections of the industry.

Automobile Developments.

Whilst technically this industry has made great headway, the details of which are authoritatively described by Mr. Percy Pritchard, trading conditions have been fairly weak. The number of new licenses has decreased, but further analysis shows that there has been a relatively increased demand for the lower powered cars. This no doubt accounts for the activity in the Austin foundry, which has been mechanised to a large extent during the past year. As money will not be expended so lavishly on roads in the immediate future, the cars having a more robust construction and improved springing will command more attention. This year has also seen the Dagenham works of Messrs. Henry Ford & Son put into production. First of all, they assembled trucks, and just recently pleasure cars are coming off the line. A jobbing foundry is just about to be started, and a few months' time should see the production foundry under weigh. They have placed considerable contracts for its equipment, including the conveyors and the melting plant.

Agricultural Implements.

The big groups in this industry have been consolidating their manufacturing resources. Agricultural and General Engineers, Limited, have closed their Peterborough foundry and transferred its equipment and patterns to Rochester. There has been a good deal of change in personnel, and this year should see these concerns reap the benefit of their enterprise.

Railway Foundries.

Mr. T. Henry Turner elsewhere has made a succinct statement of the present tendencies in railway foundry practice. Never before have the chief engineering executives of the railway companies taken such interest in the foundries under their control. Whilst they are extremely conservative in their actions, we should not be surprised if one of the companies does not delegate a high official to co-ordinate and rationalise the foundry activities. It is, of course, convenient to have a number of centres for rapid repairs, but, with modern notions of series-manufacturing, stores should be able to take care of everything other than plant renewals.

Shipbuilding.

If only commercial conditions in marine engineering were on a parity with the technical progress they have achieved in recent years they would indeed be busy. They have been so badly hit since the post-war boom that with a few exceptions they have been unable to buy modern plant. They can still make the best heavy castings in the world, and with a reasonable amount of work in the shops they would soon acquire the latest plant for their economic manufacture. The stopping of the construction of the new Cunarder was badly felt by the foundry industry, as it had just reached the stage when castings would begin to arrive by hundreds of tons. We sincerely hope that its construction will not long be delayed.

Country Jobbing Foundries.

Mr. Kenneth Jewson, who controls a foundry falling into this category, reviews their situation with cheery optimism. They are to be numbered by the thousand in Great Britain, and their conduct is a combination of a battle of wits and the luck to be supported by some local manufacturing enterprise. They need never be down and out, as there is always plenty of work for the more enterprising, as usually they are so extremely adaptable.

Other Foundries.

There still remain to be considered the foundries catering for the heavy iron and steel industries, mining, electrical engineering, printing and roll foundries. The first-named can look for better prospects this year, as it seems likely that some immediate help will be given to the industries they serve in the near future by an "abnormal importation order," whilst they seem likely to get a full measure of protection when the Budget is passed. This, too, would affect the roll founders. The electrical foundries were amongst the last to suffer, and we imagine will be one of the first to recover.

Technical Developments.

From the technical point of view the year has been by no means as melancholy as the review of commercial conditions would suggest. As far as matters of general interest are concerned, and the melting problem faces every founder who does not merely turn his back on it, the greatest interest has been taken in the rotary pulverised-fuel furnace, at least two designs of which are now likely to go forward in this country. Other types not only will arise, but indeed have arisen, although not all of them are pulverised-fuel fired. We never have accepted the view that competition is a bad thing technically. On the contrary, we are confident that the market available to two or more competitive equipment items is greater than the market open to one only. On the cupola side a new lease of life has been given to this furnace by the balanced-blast design, and a long life may be predicted for the cupola, always threatened with extinction in favour of some new type and yet always surviving on account of its economy, elasticity and general convenience.

On the metallurgical side our columns have testified to the advances made in the production of cast irons best described as austenitic, in contrast to the usual type of engineering cast iron which is pearlitic. The output is small compared with the tonnage going into ordinary products, but the engineer to-day is prepared to balance improved properties against added cost, and the result is frequently to adopt the new material. It is to these products that the founder must look for better profit margins and to meet the competition of the small man who cuts prices in ignorance of his true costs. Definite results have not yet been published in connection with cast irons treated by the new nitriding process, and details will be awaited with interest. On the testing side, the new small tensile testing machine has made a promising beginning. Heat-treatment, too, has made headway. The outstanding feature on the plant side has been the opening of the pipe plant at Staveley for making pipe in centrifugal sand moulds, and several foundries have been mechanised, wholly or in part. The striking feature of these is the close attention demanded for moulding sand, its selection, conditioning and after-treatment. Even in ordinary foundries there are many signs that sand is now receiving the attention it deserves. The influence of the commercial depression has undoubtedly tended to suppress development in one sense on account of its effect on finance but to assist it in another, for now is the time to economise, even at the cost of capital outlay.

A French development which at least possesses extreme novelty is the use of cast pure silica ware for cores and core-bars, and even permanent moulds are spoken of. The principal German development of the year seems to be the production of a high-grade high-carbon iron melted under a high-aluminous slag. Sufficient data are not yet available to pass a considered judgment on its merits. A certain amount of evidence is coming to light to show that the very best pearlitic irons, manufactured under highly-controlled conditions, may possess a brittle range. This disturbing factor certainly warrants immediate and close investigation by the best metallurgical brains in the country. Evidence is being accumulated that aluminium is best melted in coke-fired or electrically-heated furnaces, in order to avoid the presence of hydrogen either elementally or in combination as furnace gases. Prof. Hansen has put this notion forward as a cure for surface pinholing. In America, considerable progress is reported in connection with a process that uses either silicon or calcium carbide as a factor in its production. It is anticipated that we shall hear more of this process in Europe in the near future.

Foundry Equipment and Supplies.

For the first time this subject has been specifically dealt with. Mr. D. H. Wood is in a special position to speak authoritively, and the increase in melting capacity of 950 tons per day from the two new foundries he speaks of is certainly an excellent figure for the present conditions. Mr. Wood omitted to mention the rise in popularity of the core-blowing machines, nor did he mention the rumours that some of the foreign foundry equipment firms are to start up factories in Great Britain. One of these rumours is now *un fait accompli* for a popular make of German sand blast is to be made in Yorkshire.

Conclusions.

What is in store for us this year? This issue surveys the whole industry, both British and foreign, and one can only reach the conclusion that the tide has turned. The greatest adverse factor is the commodity market. If the general concession of opinion is that rock bottom prices have been reached, then despite gold-hoarding or any other factor British industry will go ahead. A much better feeling is abroad, and confidence begets confidence.

The Foundry Industry Month by Month.

January.

MR. WESLEY LAMBERT is awarded C.B.E. for meritorious work in connection with the 1929 International Foundry Congress.

DR. S. G. WERNER resigns his position as President of the German Foundry Employers' Federation after 18 years of office.

"GIESSEREI ZEITUNG" is absorbed by "Die Giesserei."

THE INSTITUTE OF BRITISH FOUNDRYMEN elects 55 new members.

SIR JAMES LITHGOW, BT., is re-elected President of the Federation of British Industries.

CENSUS OF PRODUCTION is taken.

NATIONAL FEDERATION OF IRON AND STEEL MANUFACTURERS draws attention of Government to the position of their industry.

LONDON IRON AND STEEL EXCHANGE forms Pig-iron Committee.

NATIONAL LIGHT CASTINGS ASSOCIATION, on ceasing to function, makes presentation to ex-Bailie John King.

BARON VON WITTGENSTEIN is elected President of the German Foundry Employers' Federation.

February.

BRITISH INDUSTRIES FAIR at its Birmingham Section is predominantly an exhibition of foundry products.

THE CENTRAL PIG-IRON PRODUCERS' ASSOCIATION addresses a memorandum to the Government on the position of their industry.

March.

DR. P. BARDENHEUER, of Düsseldorf, addresses Tyneside foundrymen.

DR. R. SELIGMAN is re-elected President of the Institute of Metals.

A PARTY of London foundrymen, under the leadership of Mr. J. W. Gardom, visits the Cork foundry of Messrs. Henry Ford & Son.

MR. D. H. WOOD is elected President of the Foundry Trades' Equipment and Supplies Association.

MR. JULES CURY is elected President of the French Foundry Technical Association.

April.

SCOTTISH BRANCH of Institute of British Foundrymen celebrates coming-of-age by creating the Sir Archibald MacInnes Shaw prize. It is received by the Lord Provost, who accorded local foundrymen a civic reception. Mr. A. Campion's work is recognised by a presentation.

INSTITUTE OF BRITISH FOUNDRYMEN at Council Meeting held in Glasgow elects 63 new members.

SIR MALCOLM CAMPBELL raises land speed to 246 miles per hr. British castings help.

May.

FOURTEEN TECHNICAL PAPERS are read before the German Foundry Technical Association at its 21st annual meeting.

TENTH ANNUAL CONGRESS of the French Foundry Technical Association discusses 13 technical Papers. Mr. J. H. D. Bradshaw presents the Official British Exchange Paper.

SIR CHARLES WRIGHT is elected President of the Iron and Steel Institute. Sir Harold Carpenter is awarded the Bessemer Medal. Sixteen Papers are presented for discussion before the Spring Meeting.

NO LESS THAN 36 PAPERS, together with numerous reports and shop-operating courses, are presented at the Chicago Conference of the American Foundrymen's Association. Mr. E. H. Ballard presides and Mr. Vincent C. Faulkner presents Official British Exchange Paper.

June.

ANNUAL MEETING of the Institute of British Foundrymen in Birmingham and Coventry. Mr. A. Harley is elected President. Lord Mayor accords civic reception. Mr. John Cameron, J.P., is awarded the Oliver Stubbs Medal. Eight Papers are presented for discussion, and ten works are visited. Mr. F. K. Neath and Mr. H. Hurren found to be capable honorary secretaries.

NEW SILICOSIS REGULATIONS come into force.

GROUP OF FRENCH FOUNDRIES establishes co-operative research association.

DR. C. H. DESCH, F.R.S., Professor of Metallurgy at Sheffield University, is appointed Superintendent of the Metallurgical Department of the National Physical Laboratory, in succession to Dr. W. Rosenhain, F.R.S., who is establishing himself as a consulting engineer.

H.R.H. PRINCE GEORGE visits the Metropolitan-Vickers Trafford Park Foundry.

COUNCIL MEETING of the Institute of British Foundrymen, held in Birmingham, elects 24 new members.

BRITISH NON-FERROUS METALS RESEARCH ASSOCIATION'S new premises in Euston Road are opened by Lord Rutherford.

LINCOLN SECTION of the Institute of British Foundrymen created. Mr. J. Feasey is first chairman.

July.

VISCOUNT EDNAM and Mr. S. Hilton are elected members of the Council of the Iron and Steel Institute, of which body Prof. Wüst, of Düsseldorf, is made an honorary member.

THE NEW SAND-SPUN PIPE FOUNDRY of the Staveley Coal & Iron Company, Limited, goes into production.

WAGES AGREEMENT is reached in the Scottish light-castings industry.

August.

SIR FRANCIS JOSEPH, C.B.E., is re-elected chairman of the Central Pig-iron Producers' Association, and Mr. E. J. Fox the Vice-President.

MR. CONSTANTIN SZMUKLER wins 25,000-franc prize offered by European producers of aluminium.

STRETCH OF cast-iron road is opened at Stratford.

September.

NEW INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS meets in Zürich. Dr. Rosenhain presides over Group A. Five Papers deal with testing of cast iron. Shear and tests made from small trepanned bars are relegated to research sphere. Mr. J. G. Pearce contributes the representative British Paper.

INTERNATIONAL FOUNDRY CONGRESS is held in Milan, under the chairmanship of Signor Ing. Comm. Carlo Vanzetti, C.B.E. The feature of the Exhibition is the number and types of core sand blowing machines. No less than 43 Papers are presented; Dr. A. L. Norbury presents the British Official Exchange Paper, and deals with a phase of malleable cast iron. Delegates are received by His Excellency the Prime Minister, Sig. Mussolini, H.E. the Governor of Rome, Prince Buoncompagne Ludovisi, and His Holiness the Pope.

GREAT BRITAIN departs from the Gold Standard, and new Government is formed.

SHIPPING AND ENGINEERING EXHIBITION is held at Olympia.

October.

MR. JOSEPH WARD is elected Master of the Company of Cutlers in Hallamshire.

INSTITUTE OF BRITISH FOUNDRYMEN elects 50 new members to its various grades at a Council Meeting held in Sheffield.

MR. ANDREW HARLEY, President of the Institute of British Foundrymen, becomes President of the International Committee of Technical Associations.

NEW GOVERNMENT is elected, and its membership included the following persons associated with the foundry industry:—Sir Basil Peto, Mr. P. J. Hannon, Mr. Joseph Hepworth, Sir Walter Preston, Mr. Gilbert Gledhill, Sir Frederick Mills, Sir K. P. Vaughan Morgan, Sir Gervais Rentoul, Major John Colville, Mr. Louis W. Smith and Mr. D. G. Somerville.

THIS MONTH sees the following elected as Presidents of the Sections of the Institute of British Foundrymen:—Mr. F. J. Hemming (Birmingham), Mr. T. A. Spiers (East Midlands), Mr. J. Feasey (Lincoln), Mr. R. W. Stubbs (Manchester), Mr. A. Jackson (Burnley), Mr. H. C. Dews (London), Mr. A. Gilbert Harrison (Middlesbrough), Mr. F. Allan (Newcastle), Mr. N. McManus (Glasgow), Mr. J. M. Primrose (Falkirk), Mr. G. C. Castle (Sheffield), Mr. A. S. Worcester (W. Riding) and Mr. R. J. Richardson (Wales).

November.

THE 10TH ANNUAL MEETING of the British Cast Iron Research Association re-elects Sir Harold Hartley, F.R.S., as its President.

PROF. JOHN H. ANDREW is appointed to the chair of metallurgy at the University of Sheffield, vacating a similar position held in the Royal Technical College, Glasgow.

MAJOR D. J. COLVILLE, M.P., is appointed secretary to the Department of Overseas Trade.

MR. WILLIAM REAVELL is re-elected President of the British Engineers' Association.

PUBLIC WORKS EXHIBITION is held at the Agricultural Hall. Cast-iron roads are featured.

SIGNOR ING. COMM. C. VANZETTI, C.B.E., receives the decoration of Cavaliere al Merito del Lavoro in recognition of his services to International Foundry Committee.

December.

A NEW SECTION of the Institute of British Foundrymen is inaugurated in Preston.

MR. A. G. LOGAN, a prominent foundry trade-union leader, is elected Provost of Falkirk.

A NEW GRINDING-WHEEL FACTORY is opened at Welwyn Garden City.

SIR GERVAIS RENTOUL, K.C., M.P., is guest of honour at the London foundrymen's annual dinner.

BRITISH ENGINEERING STANDARDS ASSOCIATION is reorganised under the title of British Standards Institution.

We have Received:—

Calendars and Diaries.

In our issue of December 31 we gratefully acknowledged receipt of a number of diaries. Since that time a further batch has arrived from both readers and advertisers and again we express our thanks and reciprocate the messages of good will which accompanied them. **Messrs. Thos. E. Gray & Company, Limited,** 119, High Holborn, London, W.C.1., have sent us a daily tear-off wall calendar; **Messrs. Gibbons Brothers, Limited,** of Dudley, a desk blotter and calendar combined; **Messrs. Stewarts & Lloyds, Limited,** Winchester House, Old Broad Street, a pocket diary; **Messrs. Silica S.A.,** of Belgium (per Mr. Sydney Evans, of 22, Laurence Pountney Lane, London, E.C.4) a pocket diary—this contains some excellent technical data; **Messrs. Thomas L. Hale, (Tipton), Limited,** Dudley Port, Staffs, a daily tear-off wall calendar; **Messrs. Smith & Fawcett,** Horton Works, Lidget Green, Bradford, a monthly tear-off wall calendar carrying illustrations of their works; **The United Steel Companies, Limited,** Sheffield, tear-off engagement calendar; **Messrs. H. Hendra & Son,** Townmead Iron Foundry, Beddington Lane, Croydon, a monthly tear-off wall calendar; **Messrs. Crofts (Engineers), Limited,** Bradford, a monthly tear-off calendar; **The British Chilled Roll and Engineering Company, Limited,** Haverton Hill, near Middlesbrough, a combined desk blotter, engagement calendar and diary; **Messrs. Joseph Henry, Limited,** Mann Road, Holbeck, Leeds, a beautifully illustrated daily tear-off wall calendar.

NOTED WOOD CARVERS.—Continuing the series of brochures dealing with famous men and Carron Works, the latest issue gives interesting facts regarding the association of the brothers William and Henry Haworth, whose wood carvings gave character to Carron productions and whose designs are incorporated in models of hob grates and interiors which are being manufactured to-day. Sons of Samuel Haworth, a noted carver in London, the brothers created a distinctive style of ornamentation which did much to develop the ironfounding industry of Scotland. Henry Haworth took up duty at Carron as a designer and carver in 1779, the year in which his father died. Unfortunately, his career was cut short—he succumbed to a chill two years later. William, however, lived and worked at Carron for 56 years, and died at his residence in the Old Forge Row, Carron.

XUM

Commercial Developments in the Light-Castings Industry.

By SIR GERVAIS RENTOUL, K.C., M.P. (President, British Ironfounders' Association).

THE Editor of THE FOUNDRY TRADE JOURNAL has invited me, as President of the British Ironfounders' Association, to review briefly our activities during the past twelve months, and to this invitation I have gladly responded.

Not being, of course, qualified to speak as to the purely technical side of the industry, I must leave others to comment upon such improvements in methods of production, engineering efficiency, and similar details as have taken place. Indeed, many of these matters have received a considerable measure of attention from time to time in the columns of this JOURNAL.

My purpose is simply to write something about the work of the British Ironfounders' Association as such, and to summarise the efforts that have been made during the past year to bring about an improvement in the economic sphere.

When the Association commenced to function some twelve months ago there was one outstanding problem with which we were faced and which for the time being overshadowed all else. And in spite of the undoubted progress which has recently been made this problem still remains.

On every side to-day the complaint most frequently heard is not so much as to bad trade

EXPORTS OF CAST PIPES AND FITTINGS FROM THE UNITED KINGDOM FOR THE LAST EIGHT YEARS.

Year.	Tons.	£
1924	84,438	1,306,627
1925	94,251	1,348,900
1926	86,984	1,148,758
1927	122,823	1,495,251
1928	114,189	1,321,662
1929	136,107	1,455,202
1930	116,305	1,294,041
1931	72,776	804,930

and the widespread industrial slump, but more specifically as to internal and unnecessary cutting of prices among those engaged in the industry itself. For some time past this has been on such a scale and to such an extent as in many cases to render it impossible to manufacture certain classes of goods on anything approaching a remunerative basis of profit. Such competition is admitted to be indefensible and suicidal. But when it exists, how can it be prevented in these days of intensive competition and business scramble, with production for the moment considerably outstripping demand? First of all, it is necessary to try and inculcate an appreciation of certain fundamental economic ideas, such, for example, as that the real test of a successful business is not to be found in turnover divorced from profit, but in turnover that has some definite relationship to profits. This may sound elementary, yet it is surprising how often its importance is overlooked.

From a practical point of view, such uneconomic competition can only be dealt with by co-operative action and by some definite agreement which will be honourably maintained by those concerned.

It is therefore upon these lines that the British Ironfounders' Association has been earnestly working during the past year. Its efforts have been concentrated on an attempt to bring home to its members the short-sightedness of allowing prices to be forced down to an altogether unnecessary extent by a competition among themselves which has no relation to the reasonable costs of production, or the necessity of ensuring an adequate margin of profit.

It was felt that with goodwill and a certain measure of give and take, it ought not to be impossible to arrive at an agreement to maintain and stabilise prices on such a level as would give a fair return for the labour expended. If, however, this was to be done, it seemed evident that such agreement must cover not only the productive, but the distributive side of the industry as well.

Early in 1931, therefore, soundings were taken among the merchant organisations, in order to ascertain their views, and it was found, as had been anticipated, that a similar dissatisfaction prevailed among the merchants as among manufacturers with regard to present economic conditions, and an equal desire to try and remedy the situation by a friendly understanding and agreement.

As a result of these preliminary inquiries

SIR GERVAIS RENTOUL, K.C., M.P.

further negotiations with all the recognised Merchant Associations in Great Britain and Ireland were undertaken, and after many months of discussion an agreement was drawn up on paper which it is believed would ensure fair play to manufacturer, merchant and consumer alike.

This agreement was approved in due course, not only by the members of the British Ironfounders' Association, but also by all those organisations which claim any title to speak on behalf of the distributors.

Having regard, however, to past experience, it had been looked upon as fundamental throughout the procedings that before such an agreement could be put into practical effect, an assurance must be obtained that adequate support would be forthcoming to ensure a faithful adherence to its terms. In other words, the futility of attempting to work agreements of this nature or of trying to stabilise prices on a remunerative basis was fully recognised if there remained outside the agreement any substantial body of founders or merchants, desirous of exploiting the situation to the detriment of those who were working in association, or willing to cut prices below the agreed levels, in the hope of snatching business from their competitors in the trade who were attempting honourably to carry out their obligations under the terms of the agreement. Cut-throat competition of this kind, however excusable in the past, is certainly not consistent with present industrial conditions.

As a result of the efforts that have been made the situation now is that an agreement has been drawn up, which on its merits has not been challenged or criticised, and which, on the contrary, has been rightly described by those best qualified to express an opinion as a remarkable achievement and as one of the best agreements that has ever existed in the light-castings industry. Moreover it is believed by the great majority of founders and merchants that this agreement could not fail to be of the utmost benefit to the industry as a whole. Unfortunately, however, there are still a few manufacturers who apparently cherish hopes, fears or secret prejudices which prevent them from co-operating, and this in its turn prevents others from lending their aid, and thereby progress is delayed. Nevertheless, it is questionable whether an attitude so illogical and indefensible can prevail for long.

The depressed state of the industry, largely owing to price cutting, is universally admitted even by the non-co-operators. Yet they have no remedy of their own to offer, and at the same

EXPORTS OF BUILDERS' CASTINGS FROM THE UNITED KINGDOM FOR THE LAST EIGHT YEARS.

Year.	Tons.	£
1924	16,004	721,231
1925	19,141	873,761
1926	19,668	882,118
1927	17,929	829,644
1928	19,682	876,745
1929	20,522	928,274
1930	17,852	796,865
1931	13,972	620,457

time will not join with the majority in an attempt to bring about an improvement even under the present conditions or prepare to reap the advantages of better times when they come. The British Ironfounders' Association nevertheless will continue its efforts in conjunction with the merchants, and I hope as a result that further progress may be made in the near future, and that the work which has been so admirably begun during 1931 may be carried to full fruition in the months that lie ahead, and that, consequently, 1932 may mark the real turning point in the modern economic history of the light-castings industry.

A Corrosion Report.

The First Report of the Joint Corrosion Committee of the Iron and Steel Institute and the National Federation of Iron and Steel Manufacturers to the Iron and Steel Industrial Research Council (published by the Iron and Steel Institute, 28, Victoria Street, London, S.W.1), is an excellent and illuminating Report, which is, unfortunately, from our point of view, confined to ordinary and special steels, though a cast-iron silicon alloy containing 15 per cent. of silicon was used by Dr. W. H. Hatfield in his laboratory experiments, and it certainly showed up very well in comparison with the other samples used. The foundry industry would probably benefit by taking more than an academic interest in these investigations.

The Pig-Iron Trade in 1931.

By D. N. TURNER (Managing Director of the Staveley Coal & Iron Company, Limited).

JUST a year ago Mr. E. J. Fox wrote an article in THE FOUNDRY TRADE JOURNAL, in which he began by saying that at the beginning of 1930 the industry was showing signs of a falling-off, and that by the end of March in that year the demand had slackened off a good deal. He pointed out that in spite of two reductions in price this falling-off continued during the year.

The year 1931 opened with very depressing conditions, and in May the Central Pig-Iron Producers' Association again made a further reduction in price in an endeavour to stimulate buyirg, and this, too, proved quite abortive. It is true that the price of coke had fallen, and the users of pig-iron were not slow to urge this as a reason for lower prices of iron. The price of coke was quite unremunerative to the coke-makers, and they in their turn must have suffered considerably.

PRODUCTION OF FOUNDRY PIG-IRON IN THE UNITED KINGDOM FOR THE LAST FIVE YEARS.

Year.	Tons.
1927	1,892,500
1928	1,539,600
1929	1,469,300
1930	1,434,200
1931 (estimated)	1,151,000

MONTHLY PRODUCTION OF FOUNDRY PIG-IRON IN THE UNITED KINGDOM DURING 1931.

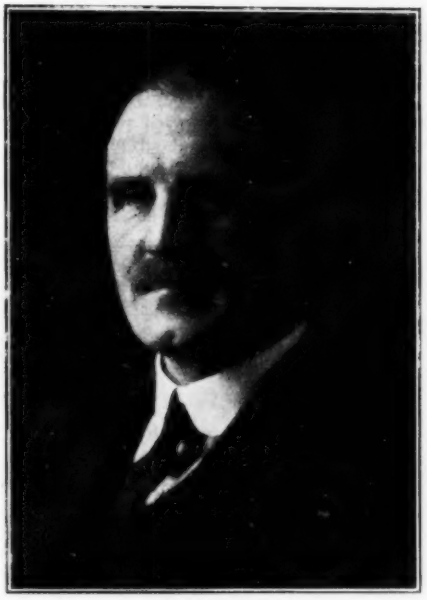
Month.	Tons.
January	93,700
February	86,900
March	111,600
April	97,200
May	107,100
June	100 200
July	95,300
August	89,900
September	89,100
October	94,100
November	89,300
December (estimated)	96,600

In spite of the reductions by the furnace-owners, foreign pig-iron continued to arrive in the country. During the eleven months to the end of November, 1931, the imports were as follow:—

Forge and foundry	101,449	tons.
Acid	22,068	,,
Basic	140,239	,,

and in addition, to make matters worse, large quantities of scrap were imported to add to the difficulties caused by the large quantities of home scrap which were available. This scrap could be bought at well under 40s. per ton, delivered into customers' works.

Towards the end of September, consequent upon our departure from the gold standard and the threat of protection, a distinct improvement set in. Except in a few cases buyers were not very willing to take immediate deliveries, and this was quite understandable, seeing that there was no real improvement in the engineering trades. It looked, therefore, as if producers in a very short time would again be faced with having to finance dead stock, or damp down their furnaces.



MR. D. N. TURNER.

Then the price of coke began to harden, and there was more talk of protection. At the time of writing, this position continues, but fortunately rather more orders for deliveries are being received.

Owing to the quota system imposed upon colliery owners, coking slack, and consequently coke, is not so readily obtainable. It seems likely that in the near future, when the present stocks of pig-iron have been reduced, and the importation of cheap foreign machinery has been checked, that there will again be an improvement in the trade for those companies who can withstand the financial strain.

On January 1, 1931, the number of furnaces in blast was 91 out of a total of 354 in existence. By the end of September this number had been reduced to 62. Whilst there are reports and rumours of one or two having been blown in during the past few weeks, it is quite evident that only those which are the most economical will be able to survive.

During the past year there has been a greater tendency to buy iron to analysis than there used to be. Close specifications should warrant an increase in price, as they mean an extra expense to the seller, both in the cost of analysis and in the stocking according to analysis.

Stocks held by the ironmasters in the Midlands are at the present time large, but should there be any real improvement in the demand these ought to quickly disappear. Had it not been that the demand for cast-iron pipes during the past twelve months had been fairly good, these stocks would have been much larger. At the time of writing there is no sign that the demand for pipes is falling-off.

IMPORTS OF FOUNDRY PIG-IRON INTO THE UNITED KINGDOM FOR THE LAST FIVE YEARS.

Year.	Tons.
1927	241,943
1928	38,718
1929	45 470
1930	117,311
1931	109,265

EXPORTS OF FOUNDRY PIG-IRON FROM THE UNITED KINGDOM FOR THE LAST FIVE YEARS.

Year.	Tons.
1927	142,330
1928	231,513
1929	194,497
1930	138,380
1931	80,071

So far as the coming year is concerned, all eyes are turned on the Government to see what they will do with regard to importations of iron. A duty on imported scrap would probably have more effect than on pig-iron. There seems to be no reason, however, why both should not come under review, and if it were decided to impose a duty there would probably be a good year, not only for the owners of blast furnaces, but also for the owners of coking-slack collieries, coke-oven owners, and iron-ore and limestone producers.

An American Symposium on Steel Castings.

The American Society for Testing Materials and the American Foundrymen's Association are collaborating for the organisation of a symposium on steel castings to be held later this year. The subjects to be covered are:—(1) Survey of the steel-castings industry, (2) statistics covering steel castings, (3) design for several angles, (4) heat-treatment, (5) test-bar specifications, (6) data and field of application, (7) alloy-steel castings—pearlitic, nickel chrome and managanese, and (8) welding.

Notes from I.B.F. Branches.

Lancashire Branch.—At a meeting held on January 9 in the Manchester College of Technology, Mr. R. Stubbs (Branch-President) in the chair, a vote of sympathy to the relatives of the late Mr. Oliver Stubbs was passed. In proposing the vote, MR. E. FLOWER said Mr. Oliver Stubbs was the most distinguished member of their Branch, one of the founders of the Cast Iron Research Association, and twice President of the Institute. His death was mourned by the whole foundry industry. Similar votes of sympathy were accorded to the relatives of Mr. Allbutt, a former secretary of the Institute, and Mr. Hollingworth, who succeeded him in that office.

Publications Received.

Proceedings of the Institution of Mechanical Engineers, Vol. 120.—Whilst this particular volume does not contain any Paper directly dealing with foundry practice, there are several subjects which are of indirect interest to certain sections, such as high-pressure locomotives, turbine development; and two Papers of general interest—"Obsolescence and Organisation" and "The Training of an Engineer."

Index to A.S.T.M. Standards and Tentative Standards as to September, 1931. Published by the American Society for Testing Materials, 1315, Spruce Street, Philadelphia, Pa., U.S.A. This Association has now standardised 443 materials on methods, whilst a further 100 are on probation; of these 10 are devoted to cast iron and a further 20 to other forms of castings.

The British Steel Foundry Industry in 1931.

By J. DESCHAMPS (Managing Director, Messrs. Kryn & Lahy, Limited).

THE acute depression which set in towards the middle of 1930 in the steel foundry industry gradually increased in severity in 1931 until it reached recently such a point, that it is probably true to say that no steel foundry in this country is now operating at more than 50 per cent. of 1930 output, which was already well below capacity.

I am of the opinion that this sorry state of affairs is not due to excessive imports of steel castings, which did not reach 10 per cent. of the home output, but is a consequence of the world-wide economic depression, from which Great Britain has been suffering at least as much as the other industrial nations. The number of steel foundries in activity has not increased, and the productive capacity of those which have been working has probably not been augmented in 1931.

PRODUCTION OF STEEL CASTINGS IN THE UNITED KINGDOM FOR THE LAST FIVE YEARS.

Year.	Tons.
1927	163,300
1928	162,600
1929	166,900
1930	177,300
1931 (estimated)	127,000

Since the end of the war, the output capacity for steel castings in Great Britain has been greatly in excess of the demand, and this lack of balance has been, of course, greatly intensified of late owing to the industrial slump.

MONTHLY PRODUCTION OF STEEL CASTINGS IN THE UNITED KINGDOM DURING 1931.

Month.	Tons.
January	7,700
February	9,500
March	10,700
April	9,800
May	11,400
June	12,300
July	11,800
August	9,700
September	11,900
October	11,100
November	11,100
December (estimated)	10,000

I believe, however, that in normal times, this output capacity will prove not to exceed the country's requirements. In U.S.A. (where the steel foundries are now operating at not more than about 20 per cent. of capacity) the annual consumption of steel castings per head of the population is about three times higher than it is in this country, and the position is the same in most of West European industrial countries. There is no reason why a similar state of affairs should not obtain in this country in the future.

Owing to a deplorable lack of understanding and co-operation between British steel founders the prices obtainable for steel castings have, in a restricted market, been steadily reduced, until they have now reached definitely unremunerative levels, and there is no doubt that, if the present policy of selling below cost with a view to achieving an increased output goes on unchecked, several foundries will be compelled to shut down in the near future.

It would be much better for all concerned if, instead of the present internecine competition, some reduction in capacity were to take place by agreement amongst steel founders, but all attempts towards this desirable end have, unfortunately, not yet met with success. The imperative necessity of reducing production costs has, however, had the advantage of compelling most steel foundries to improve their manufacturing methods.

Substantial savings have, in some cases, been made in the cost of moulding sand per unit of output. It has been found that properly-prepared synthetic facing sands could be produced from all-British raw materials at a much lower cost than that of proprietary mixtures or imported foreign natural sands and yield entirely satisfactory results.

Improvements in the quality of steel have also taken place, and I would like to suggest that there is still room for much progress in this direction. The authorities responsible for drafting specifications could be of considerable help in insisting on much improved physical characteristics for the metal instead of adhering to unreasonably low levels the limits assigned for the presence of such impurities as sulphur and phosphorus. For instance, they could ask for a much higher tensile strength for a given elongation, or, alternatively, for a much greater elongation for a given ultimate tensile strength. I would even suggest that a cold-bend test of 90 deg. minimum be specified for steel used for castings with wearing surfaces, for which most existing specifications are only requiring 35 tons tensile per sq. in., coupled with a minimum elongation of 10 per cent. and no bend test.

MR. J. DESCHAMPS.

I am aware I will be asked how it is going to help the industry to ask for specifications which some steel founders may find it difficult to meet?

My answer is that an ideal way to "rationalise" an industry is to concentrate it in the hands of those who can produce the better article. This would be a means of achieving "capacity reduction," which would not involve the efficient firms in the extra expenditure which would be required by any other method.

I believe also that it will be found practicable to produce, in the near future, high-quality steel for the steel foundry from pulverised coal-fired rotary furnaces, at a cost considerably below that at which metal of equivalent quality is now obtained from the electric and open-hearth furnaces.

The recent drop in the value of sterling in those countries which are our most important competitors on the Continent is equivalent to an import duty of about 30 per cent. at this moment. If, in addition, a specific duty is imposed, not only on steel castings but on raw and semi-finished steel, it would give an added advantage to large users of steel castings, with resulting benefits to our industry.

I feel, therefore, that, if increasing efforts continue to be made to reduce costs at home (which I am convinced can be done), and if the international value of the pound sterling remains at its present depreciated level, whilst retaining approximately its purchasing value at home (hence obviating the necessity to increase wages), the future of the British steel foundry industry will be brighter than the unfortunate experiences of the year 1931 may have led us to believe.

IMPORTS OF STEEL CASTINGS INTO THE UNITED KINGDOM FOR THE LAST FIVE YEARS.

Year.	Tons.
1927	9,500
1928	12,900
1929	14,200
1930	12,400
1931	6,500

EXPORTS OF STEEL CASTINGS INTO THE UNITED KINGDOM FOR THE LAST FIVE YEARS.

Year.	Tons.
1927	1,300
1928	800
1929	1,500
1930	2,100
1931	1,100

With its unequalled natural resources and the skill of its workpeople, this country should, and I am convinced will again, given a fair chance, lead the world in the metallurgy of iron and steel and in its special branch of steel founding.

Random Shots.

"Marksman" never regarded football as a dangerous sport until a few days ago, when he read, with surprise, that in the U.S.A. during 1931 no less than 43 footballers were killed or succumbed to injuries. He read, at the same time, that nine bull-fighters were killed in Spain, while 95 were injured. And what he is wondering now is, whether it is more dangerous for an American football player to tackle unarmed a bull in a Spanish arena, or for a Spanish bull-fighter to venture on to an American football pitch.

* * *

TRAVEL STORIES.

"I was in the middle of a jungle when suddenly I saw a horde of savages charging in my direction."

"Good heavens! What did you do!"

"Just stared at them until I was black in the face, and they mistook me for one of their own tribe."

* * *

Said an American (on his first trip to this country), entering a railway carriage marked "Smoking": "You seem to have coaches for everything in this country. In the last few days I've seen carriages labelled 'Sandwich,' 'Bath and 'Reading.'"

MARKSMAN.

Foundry Research in 1931.

By Sir HAROLD HARTLEY, C.B.E., M.C., F.R.S. (President, British Cast Iron Research Association).

THE strength and other properties of cast iron have to be considered in relation to two main factors, the intrinsic properties of the metal itself and the soundness or otherwise of the casting into which the metal is made. These two factors require to be carefully distinguished in discussing the strength and properties of cast iron and particularly the test-bar problem, as otherwise confusion of thought is bound to arise.

Influence of the Elements of Composition.

The properties of the metal cast in such a way as to be perfectly sound and homogeneous are influenced in two ways, firstly by composition, that is, the elements of which it is composed, and secondly, as shown by previous investigations carried out by the Cast Iron Research Association, by the conditions under which it is melted. Cast iron is the most complex alloy with which the metallurgist has to deal. The number of elements present in the structure, the variety of their combinations and the extent of their mutual solubilities all have to be considered. Each element has several influences (*e.g.*, graphitising or otherwise, toughening or embrittling, raising or lowering the pearlite change point, etc.), which in some cases reinforce each other and in others offset each other. Even the alloy steels, therefore, do not present so complicated a problem as the alloy cast irons. The study of the influence of elements of composition on cast iron is one to which contributions have been made by metallurgists in all industrial countries over a period of years, and, speaking generally, the influence of these elements, taken individually and separately, is well known. Very little work, however, has been done on the joint influence of two or more elements taken together, and one of the first problems which faced the Cast Iron Research Association was to determine these joint influences, which are by no means the mere algebraic sum of the individual effects.

Silicon.

The influence of silicon in promoting the formation of graphite is well known, but one result of the studies carried out by the Research Association was the discovery that when silicon is added in proportions higher than are normally used in grey cast iron a series of irons is produced different in structure from ordinary grey irons (which are normally composed of pearlite and flake graphite), these consisting of ferrite and a particularly fine form of graphite now termed "supercooled" graphite. It was found that these irons were very much more resistant to heating and scaling[1] than ordinary grey irons, and this series of alloys (Silal irons) is now finding industrial use for many purposes where resistance to oxidation and high temperature (up to 900 deg. C.) is required.

It was found necessary to study the influence of each of these elements over wider ranges than has hitherto been usual, because the multiplicity of influences at work makes it very difficult to ascertain the precise effect of a change in the amount of one element present when it is made only within narrow limits. The influence of silicon has, therefore, been studied up to over 15 per cent., and the results make it possible to say with much greater confidence what is likely to happen in normal mixtures.

Manganese.

The influence of manganese is also well known, but until recently a certain amount of difficulty arose because the normal influence of manganese, through the formation of manganese carbide, is affected by the relationship between manganese and sulphur, and a number of cases were met in industrial practice in which an increase in manganese instead of hardening the metal and increasing the chilling properties, as anticipated, actually had the reverse effect. This has now been satisfactorily settled, and the influence of manganese up to much higher percentages than are normally found in practice, about 15 per cent., has been studied.

Total Carbon and Conditions of Melting.

The influence of total carbon is one which is particularly complicated, because it cannot yet

SIR HAROLD HARTLEY, C.B.E., M.C., F.R.S.

be expressed in quantitative terms. In the ordinary way cast iron solidifies, so that part of the carbon exists in the combined form as iron carbide (cementite), which forms one of the two constituents of the duplex material pearlite, and in white or mottled irons appears in the free state. The remainder of the total carbon, not accounted for by the carbide in one or other of these two forms, is present as free graphite. Variations in the behaviour of cast iron are found to exist in practice, even when the composition remains the same, and a study of this question resulted in the discovery that irons could be produced with different structures even with the same composition.[2] In the extreme case the structure may take the form of ferrite with fine or supercooled graphite; in other cases, for the same composition, it may be pearlite and flake graphite. Alternatively, the structure may be a mixture of these two. It is obvious that uniformity of properties demands uniformity of structure, and consequently castings containing this mixed structure are to be avoided. For some purposes the ferrite: fine-graphite structure is preferable, in others pearlite: flake-graphite, and it is of considerable industrial importance to know how to control the material to get one or other and how to avoid mixture of the two. Such control can only be exercised in the most effective way if the reason for the variations is known, and a theory had to be evolved to explain the differences and how they arose. The germ theory was found to do this fairly satisfactorily, and it was discovered that the presence of graphite in the melt was a determining factor in settling whether the structure should be the first or the second of the two mentioned above, and that speed of cooling was a determining factor in settling whether the structure is mixed or not if graphite is present, and whether it is white or not if graphite is absent. It was found that if the metal were melted under such conditions that the whole of the graphite in the original charge was dissolved, conditions that require a high melting-temperature, the ferrite: supercooled-graphite structure resulted. If the charge was melted under such conditions that the graphite was not wholly dissolved, it was found that the pearlite: flake-graphite structure was obtained, the flakes apparently building up on the undissolved graphite nuclei.

The duration as well as temperature of melting is of considerable importance, as obviously a charge containing coarse graphite requires a longer time or a higher temperature to dissolve the graphite than a charge containing relatively fine graphite or no graphite at all. Cast iron is mechanically strongest when the graphite is in the fine-flake condition, that is, when it has a pearlitic structure, but with the finest flake size that can be produced with such a structure. In ordinary melting procedure the graphite is apt to grow to large flakes in heavy sections and hence to give openness of grain in those sections, leading to diminished strength. The experiment was tried of melting an iron containing no graphite (for example, a white iron) and also of melting an ordinary iron at such temperatures that the graphite was completely dissolved (ensuring the complete removal of graphite nuclei), followed by the artificial production of graphite in the ladle by inoculating the melt in each case with graphite or a graphite-provoking material. This appears to result in an iron with a finer graphite structure, and hence greater mechanical strength than can be obtained in the ordinary way. The influence of total carbon on the structure is, therefore, twofold. First of all there is the influence of the quantity of carbon present in itself, and secondly there is the effect of the undissolved nuclei on the structure arising from the melting conditions, which determine how far the graphite in the original charge is dissolved. An iron containing 4.3 per cent. of carbon passes immediately at its freezing temperature from the liquid to the solid state; it has no plastic range and is the so-called "eutectic" alloy. Such a eutectic iron requires less feeding, and shows less shrinkage and draw effects, for the reason that there is little or no pasty stage in the solidification process during which the metal contracts, and the ordinary thermal contraction is offset more or less by the slight expansion on the deposition of graphite during cooling. Silicon actually reduces the amount of carbon required to form the eutectic, so that, for example, an iron containing 2.4 per cent. of silicon is virtually eutectic with 3.5 per cent. of carbon. An iron, therefore, containing more carbon than this is "hyper-eutectic," and some of the extra carbon will normally separate out as kish. Such kish entrapped in the metal, a likely occurrence if the melting temperature is low, will diminish the strength. Irons containing less than the eutectic proportion of carbon

(" hypo-eutectic " irons) are in general stronger on account of the lesser graphite content, but have higher shrinkage than eutectic irons. The danger arising from the production of high tensile irons (all hypo-eutectic in character) is the difficulty of getting a perfectly sound casting where the design leads to shrinkage or drawing troubles or where unsuitable gating and pouring lead to inadequate feeding.

Nickel and Chromium.

During the past few years a considerable amount of work has been done on alloy cast irons, particularly nickel and chromium, but limited to small additions. The influence of nickel has been studied by the Research Association up to over 30 per cent. and of chromium up to 15 per cent. Nickel, while exerting a greying effect like silicon, is much less drastic in this respect than silicon and a balanced composition, in which the silicon is reduced according to the nickel added, is found an improvement for a number of purposes. Paradoxically, nickel assists in retaining in the grey state thin sections which in the absence of nickel would tend to go white and cementitic, while it also tends to retain in the pearlitic condition thick

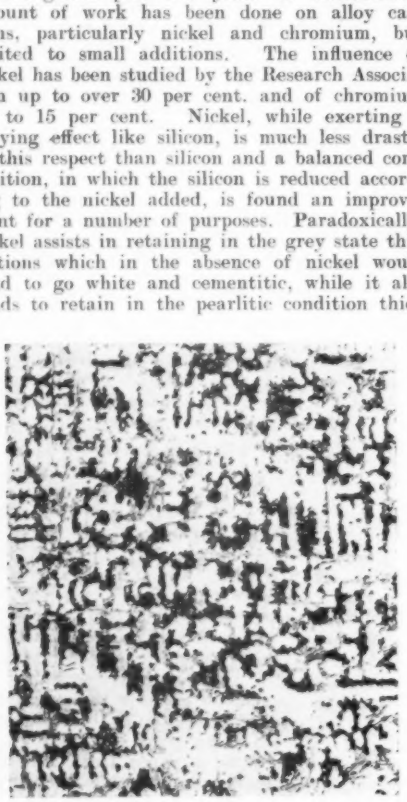


FIG. 1.—TYPICAL MICROSTRUCTURE OF NICROSILAL. ETCHED, × 50 DIAS.

sections which in a nickel-free iron would tend to go soft and ferritic, with an accompanying coarse graphite. Nickel may be regarded, therefore, as assisting to maintain a desirable uniformity of structure, and hence uniformity of properties over the varied sections of a casting. It has also been found that nickel tends to suppress the formation of the ferrite:fine-graphite structure occasionally found, especially in rapidly cooled irons, in the ordinary pearlite. Since the ferrite:fine-graphite is much softer than pearlite this action is also hardening in character and makes for uniformity. Chromium has a drastic carbide-stabilising action opposite to that of silicon and nickel, and hence chromium can only be used in small quantities for grey irons. Here again a balanced composition is desirable. Molybdenum also exerts a striking action, the full nature of which yet remains to be elucidated by further experiment, although various experiments are agreed that it improves the mechanical properties.

Nicrosilal.

The high silicon irons (Silal) referred to above as having special heat-resisting properties are apt to be rather brittle in the cold state, and attempts have been made to produce irons with similar heat-resisting properties, but having a small measure of ductility. This has been successfully achieved in the production by the Research Association of an alloy known as Nicrosilal, which is a high silicon iron of similar type to Silal in silicon and carbon content, but containing nickel and chromium. Tests have shown that this material is even more resistant to scaling and oxidation than the Silal irons, and in addition it has in the cold a measure of toughness or ductility. In fact, bars have been produced which have a bend test comparable with that of white-heart malleable on similar sections. Independent tests have shown that Nicrosilal will not scale even up to the melting point. The strength of heat-resisting irons at high temperatures is important, and ordinary engineering irons at temperatures of 800 deg. C. to 1,000 deg. C. are semi-plastic. Ordinary Silal is much more rigid under load and Nicrosilal still more so at these temperatures. Independent tests have shown that Nicrosilal has a tensile strength of between 2 and 3 tons per sq. in. at 850 deg. C. The heat-resisting properties of the alloy iron may be judged from the fact that a series of bars of varying compositions were heated in a gas muffle furnace for seven periods of half-an-hour each at 1,000 deg. C. A mild steel scaled badly. An engineering iron of 1.7 per cent. silicon scaled badly and grew 16 per cent. by volume. A Silal containing 5.6 per cent. silicon grew 5 per cent. (Silal is not usually recommended for working temperatures over 900 deg C.). The alloy material Nicrosilal grew only 1.3 per cent., coming out practically untarnished. This growth is only about one-fourth of the ordinary thermal expansion at the temperature mentioned, so that provision made by the engineer or designer for thermal expansion takes care of growth.

During the past year the investigations carried out by the Research Association on the influence of these various elements, singly and conjointly, have been virtually completed, with the result that it is now possible for the first time to say what structure may be expected from any iron in any given combination of elements, say up to four in number. Very broadly, the structure of the metal determines the properties it may be expected to have, so that various alloys can now be designed to suit any industrial purpose that the engineer may have to meet. The elements dealt with, apart from carbon (the effect of which, as explained above, cannot be stated in quantitative terms), are silicon, manganese, nickel and chromium. The influence of phosphorus is also well understood, although the nature of the so-called phosphide eutectic has not yet been fully explored, particularly its variation with silicon content and rate of cooling. Its effect on properties, however, is quite well known. The influence of sulphur is also well understood, and effects dependent on sulphur can generally be secured by suitable adjustment of the manganese content, or by desulphurisation with soda-ash.

It should be particularly noted that both Silal and Nicrosilal are easily machinable, the former up to a content of about 10 per cent. silicon. In the case of the latter, where the working conditions make it possible to use an unmachinable material, this can readily be obtained with

BIBLIOGRAPHY.

1 NORBURY, A. L., and MORGAN, E.—" The Effect of Carbon and Silicon on the Growth and Scaling of Grey Cast Iron." Iron and Steel Institute, Journal, v. 123, 1931, No. 1, pp. 413–414. See also British Cast Iron Research Association, " Bulletin," April, 1931, p. 364; and October, 1931, p. 35.

2 See account summarised in PEARCE, J. G.—" Recent Developments in Cast Iron and Foundry Practice in Great Britain." Institute of British Foundrymen, preprint of Paper read at the Annual Conference, June, 1931.

3 PEARCE, J. G.—" The Structure and Mechanical Properties of Cast Iron." New International Association for Testing Materials. Preprint of Paper read at the meeting at Zürich, 1931.

4 NORBURY, A. L.—" Mechanical Properties of Malleable Cast Irons on Various-Sized Test-Bars." International Foundry Congress, Milan, September, 1931. British Exchange Paper of the Institute of British Foundrymen, reprinted in FOUNDRY TRADE JOURNAL, v. 45, September 17 and October 1, 1931.

5 SKERL, J. G. A.—" Sands and Sand Testing." Institute of British Foundrymen. Preprint of Paper read at the Annual Conference, June, 1931.

further advantage to the heat-resisting properties and without producing an iron having the brittleness usually associated with white iron. The machinable metal is austenitic in structure, and is shown in Fig. 1 at 50 dias. and in Fig. 2 at 200 dias. The Association usually prepares such photomicrographs unetched at 50 dias. to show the graphited distribution, and etched at 200 to show the matrix. In the present case the graphite photograph has been etched because the soft austenite spreads over and conceals the graphite in polishing unless removed by the etching reagent.

Soundness of Castings.

The second main question affecting the strength and properties of cast iron is the question of soundness, which includes those effects referred to by founders as openness of grain (or conversely, as closeness of grain), softness, shrinkage and drawing, porosity, etc. The Cast Iron Research Association has shown that the fracture of pig-iron and grey iron, to which founders in this country still attach considerable value, is governed entirely by the size and distribution of the graphite flakes; if the flakes are small the structure is close, and if the flakes are

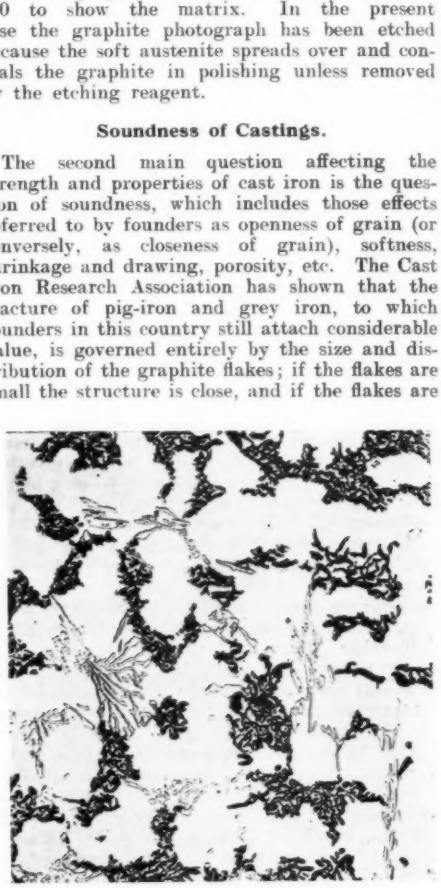


FIG. 2.—TYPICAL MICROSTRUCTURE OF NICROSILAL. ETCHED, × 200 DIAS.

large the structure is open. It has also been shown that similar fractures are obtained from different compositions. Thus an iron A of given silicon and carbon contents may have a similar fracture to an iron B with a lower silicon content if it has a higher carbon content. Fractures also vary in pigs of similar composition from different furnaces and from the same furnace at different periods, thus again emphasising the influence of melting conditions. In view of the fact referred to above that the size of the flakes is dependent upon the melting conditions, it will be seen that the fracture of the casting is dependent not merely on the composition and fracture of the original charges melted, but also on the treatment imposed by the melting itself. The effect of the method of melting on the quality of the metal is, in fact, one of the main reasons for the interest of the Association in the design and operation of melting furnaces, and its latest design, the balanced blast cupola,[2] continues to make steady progress. The number of installations actually in operation or under construction since the original development is twelve, yielding an aggregate tonnage of nearly 80 tons per hr., and in every ordinary case the saving in coke is 25 to 40 per cent., while there are further economies from diminished charges for patching. The main advantage, however, lies in the high melting temperature and the comparative freedom from oxidation. The cupola can now be supplied to members by six firms who have licences to manu-

facture from the Association, these being the leading firms in this branch of work in the country.

Size and Strength.

The work being carried out by the Association on the variation of strength with size of bar has been continued during the year. It is well known that there is a fall in the strength of cast iron as the section increases,[2] and the study of this question is very important in connection with the solution of the test-bar problem apart from its interest to the designer and the metallurgist. There is no clear and sharp dividing line between the openness of grain which shows itself in heavy sections due to slow cooling or unsuitable composition, and those defects referred to above as openness of grain and porosity causing obviously unsound castings. These defects may also be due to incorrect mixture or to incorrect melting. At other times they arise from the moulding and pouring conditions. The completion of the study of the influence of elements of composition leaves the way clear for tackling the next major problem facing the Association, that is the factors governing the production of sound castings, involving the study of the shrinkage and draw problem, and the production of sound, high-quality engineering irons. This, in one form or another, has been before the Association since its inception, but a systematic attack has necessarily had to wait on the completion of the work referred to above on the influence of elements, since composition has a major influence. The discovery of the effect of melting conditions may be regarded as the "missing link" required to make the new work possible.

An interesting illustration of the difficulty of correlating the properties of grey iron with chemical composition alone is given by work just completed by the Association on thermal and other properties of ingot moulds for steel ingots, done in conjunction with the Committee of the Iron and Steel Institute and the Iron and Steel Industrial Research Council on the Heterogeneity of Steel Ingots. While ingot mould irons conform generally to a recognised composition, they show considerable variation in properties both before and after their service life.

The Test-Bar.

Reverting to the test-bar problem, in 1928 Great Britain officially adopted through the British Engineering Standards Association, now the British Standards Institution, a specification for general grey iron castings, embodying the use of the round test-bar for tensile and transverse tests, and having three sizes of test-bar for specified average thicknesses of castings. Experience showed the desirability of relating the size of the test-bar to the size of the casting, it having been found that in some cases castings were being judged by standard test-bars thinner than their thinnest section or conversely, thicker than their thickest section. Opinion in France, stimulated by the work of Frémont, tended towards the employment of a single small test-piece trepanned from the casting itself and tested in a single shear, this test being accompanied by a transverse test on a very small separately-cast bar. For some years a good deal of controversy has taken place on the respective merits of these two methods of approach, and at a congress of the New International Association for Testing Materials held in Zürich in September last the matter came to a head, four Papers being presented on the subject at the invitation of the Congress by well-known experts,[3] followed by a discussion in which the leading metallurgists in Europe took part. Although it is no part of the business of the International Association to come to definite conclusions on controversial matters, an attempt was made at the request of the Congress by the President of Section A (Metals) (Dr. W. Rosenhain, F.R.S.) to sum up the results of this discussion, aided by summaries drawn up by the authors of four Papers, with the object of finding the maximum measure of agreement. The use of separately-cast test-bars to be tested either in tension or transverse or both (the practice adopted by Great Britain and strongly advocated by the British representatives) was supported by Belgium, Czecho-Slovakia, Germany, Holland, Switzerland and the United States. The use of the small shear test-piece trepanned from the actual casting with a supplementary bending test, as advocated by France, was supported by Italy and Spain. All countries recognised the importance of the trepanned test-piece as a means of exploring the strength of a casting and possibly also for the study of failures in service, but for the ordinary acceptance testing of castings the use of a separately-cast bar for tensile and transverse tests was supported by the overwhelming majority of the countries concerned.

The Malleable Iron Test-Bar.

An important investigation relating to the test-bar problem has also been completed for malleable iron[4], the standard test-bar for which is the 1 in. × $\frac{3}{8}$ in. flat bar for the bend test, together with a round bar for tensile test. Investigation has shown that both for bending and tensile tests the round bar is to be preferred, and furthermore that, as with grey iron, the size of the test-bar should bear a relation to the size of the casting.

Work on moulding sands, the remaining main factor in the production of sound castings, has steadily continued during the year, and a convenient summary has been published.[5]

It will thus be seen that all the major factors affecting the economical production of castings and their quality find a place in the research programme of the Association, so that the various needs of each section of the industry are dealt with. At the end of the financial year, June, 1931, the number of research reports circulated or available to members reached one hundred.

Recent Developments in the Textile Engineering Industry, with Special Reference to the Foundry Section.

By JOHN JACKSON (Foundry Manager, Howard & Bullough, Limited).

ALTHOUGH this article is primarily addressed to foundrymen, a brief commentary on developments in the textile machinery manufactured to-day will not be out of place. Many improvements in the principles of working and design of the various machines for the opening, cleaning, preparation, spinning and manufacture of cotton, have recently been introduced. The cotton cleaning machines as now made comprise single process lines of blow room machinery, which entirely eliminate the heavy beating of cotton previously in vogue. These new machines are electrically controlled, more efficient, and running expenses are less than were formerly the case.

The improvements in these machines, as well as in the carding engines for the later process, result in inestimable benefit to the operatives, due to the elimination of the fine dust and cotton-fly so prevalent in blowing and carding rooms in cotton mills. Several types of high draft spinning frames are now supplied, which produce better quality yarns at less cost than formerly. The same can be said for the special types of machines now made for the doubling of cabled yarns for the motor-tyre trade. A wider and more general application of the principles for cotton spinning are now being applied successfully in the machines for the woollen and worsted trades.

With all types of textile machines, the tendency now is to use the individual motor drive, involving the use of cast-iron bedplates and motor supports, which causes increased demands in the foundry. The above changes are fairly general, though they have not been taken advantage of by British manufacturers to the same extent as by spinners and manufacturers abroad owing to the general stagnation in the textile trade in this country during the last few years.

This marked progress in textile machines in general has not, to any appreciable extent, altered any foundry processes or systems of moulding. Nevertheless, many changes of a beneficial nature have taken place in the foundry during this era, which is keeping pace with the ever-increasing demand for an improved quality of textile machinery, together with the necessity for economy in price. To enumerate these in progressive order, cupolas have been altered from the old type positive blowers and are now driven by Keith-Blackman type fans, provided with volume-of-air-supply regulators. The old type of brick lining has been dispensed with and cupolas are now rammed lined from hearth to charging platform.

The result of these changes has been readily seen in the more regular melting of clean hot iron and in a much cleaner cupola after the day's blow, with less burning out of the melting zones. Incidentally, spalling off of the lining is now a thing of the past.

Economy in the purchase of outside scrap has been effected by using up the cast-iron borings from the machine shops; these borings, briquetted into solid blocks by means of a powerful hydraulic press, are then remelted in a measured proportion as a part of the scrap in the charge. Scrap steel is also used in various proportions in the iron charges, according to types of castings required, resulting in cleaner and stronger castings with a marked improvement in freedom from chill, increased strength and machining qualities.

The old practice of heating-up pattern plates by means of gas jets, steam pipes, charcoal, etc., has been superseded by the application of the low-temperature strip electric-heater designed to operate at black heat. A more regular temperature has been obtained by this method, at reduced cost. The old system of lifting large patterns, moulding boxes, etc., by means of jib cranes, rope cranes, etc., has been superseded by the adoption of long traverse electric cranes fitted with crawl-lifting motion.

Better types of core ovens are now in operation, which, whilst drying cores better, have a reduced coke consumption; on similar lines muffles dry the incoming red sand to ensure facing-sand of the correct moisture content. Sand, which was ever a bone of contention in the foundry, has been subjected to various experiments, resulting in the blending of fine-grain local sands, which approach in moulding pro-

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Recent Developments in the Automobile Foundry Industry.

By PERCY PRITCHARD (Managing Director, Birmingham Aluminium Casting (1903) Company, Limited).

THE past twelve months have been equally trying to the automobile foundry industry as to the rest of industry. Trade conditions have not been good, due to general depression, but, in spite of this, it is probably not an exaggeration to say that the progress made technically during the year is at least on a par, if not in advance, of that made in any other period.

Grey Iron Castings.

The cast-iron branch of the industry has made considerable headway, both in methods of production and improvement of materials. Several of the new plants, equipped with the latest mechanical handling and sand preparing machinery, have come into fuller operation, and there has been in the automobile cylinder industry much more done on the casting of cylinders in green-sand moulds, in fact it is safe to say that to-day the major percentage of cylinder blocks manufactured in this country are made in green sand, whilst, probably, the reverse applied as late as two years ago. There has been an urgent demand from the engineers for better wearing materials, which has led to the production of special high-duty cast irons, some containing nickel up to 5 per cent., others, nickel and chromium, and others, chromium only. There has been a steadily increasing demand for liners, centrifugally cast, but here again the demand has been for better wearing products, with the result that all the principal firms engaged in the manufacture of this class of product are offering a heat-treated cast iron, which is hardened after machining (but before final grinding), either by cooling in air or oil from a temperature of 820 deg. C. The composition of material used gives by this means an exceedingly good wearing iron, having a Brinell hardness of between 400 and 500.

There has also been considerable development in the use of high-duty cast iron having high tensile strengths for use as brake drums, and it has been found that a high-tensile close-grained iron gives greatly increased life and improved braking qualities over a steel drum, but, of course, on account of the strains met with in service it is essential that the cast iron used shall be the finest possible.

For the manufacture of piston rings, attention has been turned to the method used in America and on the Continent, known as the single cast ring process. The method employed abroad is to cast each ring separately with a very small machining allowance, instead of in the form of a centrifugally cast sleeve or pot, from which a number of rings are parted off (as is the case in Britain). It is claimed that the single cast method, besides being cheaper in production, gives a better wearing and more uniform ring. It is, of course, obvious that, in order to keep the castings machinable, and yet at the same time possessing the requisite hardness, great care is needed in the metallurgical control of the iron. The castings are usually made in sprays, and cast with the boxes in tiers, the bottom of one box forming the top part of the box below it, with a centre runner passing through the tier of boxes.

Aluminium Foundry Work.

In the aluminium foundry industry, whilst trade conditions have been bad, a tremendous amount of work has been done. The use of high-tensile and heat-treated alloys has been further extended, particularly with the coming of the Diesel-engined commercial vehicle, although, at the present moment, cost is a factor that is preventing their wider adoption. Research work with alloys for aluminium pistons has continued, and, whilst a completely satisfactory aluminium piston has yet to be evolved, progress has been made in improving materials and design. The majority of pistons used to-day are made in special alloys which, after heat-treatment, give a Brinell hardness of 130 to 160. The heat-treatment is generally carried out in electrical furnaces of the resister type, which are capable of being automatically controlled within very narrow ranges of temperature variations. At least one large automobile foundry has a continuous furnace of this type, capable of dealing automatically with five thousand pistons a day.

On the general sand casting of aluminium, castings are now made daily of a size which would have been considered impossible a few years ago, and castings up to 16 ft. in length and others also weighing one and a-half tons in aluminium have been produced.

MR. PERCY PRITCHARD.

On the melting of aluminium alloys considerable work has been done here, but there has been a decided change-over from the open-hearth or reverberatory type of furnace back to the crucible, the main reason for this being that the higher melting losses encountered in the open-hearth type of furnace more than counterbalance any fuel savings. As a matter of fact, recent developments in crucible type furnaces have resulted in the production of a furnace which can equal the open hearth on fuel with the advantage of considerably lower melting losses.

Die Castings.

The die casting of aluminium has continued to make progress, and here again larger and heavier castings are being made in dies, crankcases, gearboxes, and washing machine parts being typical examples. There has also been more thought given to the mechanical operation of the dies, this being done either by compressed air, hydraulic power, or, alternatively, by screws, racks and pinions.

Very considerable development has taken place in the pressure casting of aluminium, and here again both the size and weight of the castings produced have increased. As a case in point, a certain casting is being made in a multiple impression die containing eight impressions, the die weighing one and a-half tons, which, for a pressure casting, is probably the largest yet attempted. Allied to the aluminium pressure casting is the zinc-base pressure casting, and here again, owing to its comparative low cost for what is practically a finished component, this class of casting is being demanded in increasing quantities by the automobile trade, and is, for certain applications, rapidly ousting gunmetal, brass, and even cast iron. The pressure die casting of the brasses has also made considerable headway during the year, and bids fair to become an important section of the industry. The gravity die casting of the aluminium-bronzes has also received close attention, and is being further stimulated by the low price of copper.

Magnesium Castings.

Perhaps the most astonishing development in the automobile industry has been the growth of the magnesium casting section. Due to the urgent demand for weight saving, received primarily from the commercial vehicle manufacturers, the production of magnesium castings has grown enormously in the past twelve months, and, as a matter of fact, has probably increased 400 or 500 per cent., indicating that real progress has been made, and an infinite variety of articles, including six-cylinder crankcases, sumps, axle cases, aeroplane landing wheels, electric motor castings, and a thousand and one smaller components are being produced in quite big series under modern methods of production, employing sand handling plants, sand slingers and conveyors. The prices at which these castings are being sold to-day make them reasonably competitive with aluminium castings made from virgin material, and the amount of weight saved (40 per cent.) is proving a considerable inducement to the user where weight is of importance. Considerable attention has been given to the die casting of magnesium alloys, as a result of which it can now be said to be a practical and commercial proposition, and has every prospect of becoming quite a considerable branch of the automobile foundry industry.

The trend of the market for automobile castings as a whole for the past year has been decidedly downward, and prices generally have been unduly depressed. The total volume of business was not equal to the previous year, with the result that all foundries were working on much narrower margins of profit, and, in some cases, no margin at all. This has naturally led to a closer scrutiny of costs, and there is evidence in this branch of the industry of a desire for more accurate and informative methods of arriving at actual costs. The installation of such methods cannot fail to effect favourably the efficiency of the industry as a whole.

Speaking generally, therefore, the automobile casting industry has, during the past year, more than kept abreast of the times, and evidence is not wanting as to the progressive spirit obtaining in the many firms engaged in the industry. Whilst the outlook for the coming year is, at the present moment, somewhat obscure and not too hopeful, one thing is certain: given a return to better and more normal trade conditions, the automobile foundry industry is fully equipped both technically and mechanically to take advantage to the full of such an improvement.

Recent Developments and Business Conditions in the U.S.A. Foundry Industry.

By OLIVER SMALLEY (Director, Gray Iron Institute; Vice-Consul, Pittsburgh, U.S.A.).

NOT since 1875 has the index of industrial production in the United States of America reached the low level of to-day, which is 30 per cent. lower than the low point of March, 1921. Never in the memories of any living American foundry owners have conditions been so depressed as they are to-day. Foundries have closed down by the score, red ink is a familiar colour and hope at a discount. All this sounds like home reading; the Britisher, however, has possibly reached the stage where he is philosophic on the prospects of making a profit under depressed trade conditions. The American still looks with envious mind back to 1929; not all foundries here care to recognise that present conditions represent anything but a temporary set back. They do not visualise present trade demands as a yardstick which might be taken as a basis for profitable operations. Whether time will force this attitude or establish a higher industrial index is anybody's guess. Consolation is taken on the assumption that as bad as things are in the United States of America other countries are suffering more.

The President's immediate plan to stimulate business is to place in the hands of an Emergency Reconstruction Corporation $1,000,000,000 to make loans to agricultural credit agencies, establish industries, railways and financial institutions, this to flank the $500,000,000 National Credit Corporation which was recently formed as a back log to banking institutions. Moreover, the establishment of a credit of $1,000,000,000 to a Home Loan Discount Bank system is being requested. War Veterans' relief cost more than $1,000,000,000 last year and they now ask for $25,000,000 more annually. Americans have this year witnessed the inefficiency of government interferences in the Farm Board in which Public Funds of nearly $500,000,000 already have been wiped out. A budget deficit of over $2,000,000,000 has to be met.

These are stupendous sums. What they mean to industry and stability of the country is yet to be seen. The Hoover Relief Committees in all sections of the country are collecting for the voluntary plan of providing the unemployed with relief over the trying period of winter. This is the American answer to the Dole. Without compulsion, a fund is anticipated much larger than could have been gathered by a Dole and without inflicting upon this aid the heavy toll which legislation would have imposed in the collection and distribution of it.

The President of the General Electric Corporation has offered the "Swope Plan" for compulsory co-operation of all industrial units, and when organisations such as the United States Chamber of Commerce present similar proposed plans it is plain to be seen that there is a strong trend of thought along lines such as these plans suggest. One of the principal weights pressing upon business is the complete disorganisation of the railway industry of America which is one of the largest consumers of castings. This is indeed a black spectre.

Plight of Mass Production Foundries.

It is not difficult to understand that the foundry industry during 1931 received a further set back. Production foundries, mechanisation, labour-saving devices and the like are receiving an undreamed-of test. During the peak of the prosperity year of 1929 new up-to-date foundries were built by automobile, agricultural and engineering corporations. Some of those foundries have never opened, others are a serious liability and are unable to provide castings at the price previously possible by the smaller and relatively badly-equipped foundries. The writer does not know of any mass production and up-to-date mechanically equipped foundry that is paying its way to-day, whether it be for steel, malleable or grey iron.

The foundry that is standing present conditions best is the miscellaneous jobbing foundry of moderate size that is not too heavily burdened. The past year has been a year of *retrenchment* and *economies* rather than one of development and expansion. The foundry industry is taking steps to reduce losses through consolidations of existing foundries. Many engineering companies who have their own foundries have found it expedient to close down these and discovered that it is cheaper to purchase from jobbing units. Attempts have been made to maintain prices by getting a better understanding of true costs. Adoption of uniform methods for determining costs by local foundry groups and the getting together of these groups has given foundries tangible information in knowing their correct costs, how to reduce costs and measure efficiency. These have resulted in reducing cut-throat competition to some extent. Trade association activity, studies in market expansion, development of new uses for castings and so forth have also been helpful.

Technical Developments.

There have been no outstanding technical or engineering developments as applied to the foundry industry. Cast-iron foundries have seen inroads made in their product by pressed steel and welded assemblies. That these latter have been a little over-optimistic and have probably gone too far, there can be no question. But to-day is a time of low prices and has given the welder opportunity for his price argument. On the other hand, the past year has seen metallurgical science applied to grey cast iron with an understanding that indicates this elusive material is at last being stripped of its complexities. Dependable physical properties are the order of the day. Considerable progress has been made in the elucidation of the elastic properties of grey iron. A better understanding has been arrived at regarding its ductility. For example, it has been shown that modulus values may be had up to 27,000,000 lbs. per sq. in. and that "E" is a function of the quantity and form of the graphite. In some engineering cast irons of 1931 the quantity and form of graphite are under exact control.

Fatigue Properties.

Most all engineering failures are brought about by fatigue. Fatigue is a property of cast iron that has been thoroughly investigated, and, while castings may show little or no elongation or reduction of area, an endurance limit is possible that compares with steel forgings. Interpretation of these studies has seen expression in the adoption of cast-iron camshafts in many of the American automobiles, while some recent tests of camshafts show cast iron is capable of giving good service results. Electric furnaces, both of direct and the indirect arc type, are increasing in number and gaining in favour. Much was expected of the rotary pulverised-fuel melting furnaces of the Brackelsburg type, but depressed trade conditions have more than anything else prevented any real development of this melting unit in the U.S.A.

Meehanite Process.

The Meehanite process has seen extended adoption and is now in use throughout the whole of the U.S.A. New Meehanite cupola irons developed this year include:—(1) *Acid Resisting*—unattacked by sulphuric or acetic; (2) *Oil Hardening Material*: This develops full hardness on quenching in oil from 845 deg. C. without distortion. It is finding extended use in roller bearings for railway wagons, gears, spider gear wheels, drawing press and cold trimming dies, conveyor machinery, bushings, shovel and dredge parts and mill tyres, etc.; and (3) *Abrasion-Resisting Iron*, which Brinells 340 to 350, but can be machined without special tools or equipment. These castings are finding use for mine and rock castings parts, in die work and other places where wear resistance and good machinability go together.

Reclamation of Core Sand.

Reclamation of core sand by the washing method has been adopted by the Bullard Machine Company and the Caterpillar Tractor Company. Water for the operation is supplied at 400 lbs. pressure by a 5-stage centrifugal pump. Water for the washing and reclamation operation costs one cent per 1,000 galls. for the pumping operation. The water removes the cores from the castings, washes the castings, carries the sand to settling basins and removes fine and undesirable particles of sand away.

Steel Castings.

The ultimate future of steel castings is entirely dependent upon improvement in quality. Last year saw steps taken to this end. Eliminating variables, establishing more rigid control of details of operation and endeavouring to understand all happenings, has resulted in material progress so far as quality is concerned. Progress has been made in melting hot to enable manufacture of the small type of castings. Foundries have diversified their products and more foundries have entered in the manufacture of stainless steels, heat-resisting and other special alloy steels. There has been an increase in the number of high-frequency induction melting furnaces for the manufacture of small castings, both plain carbon and alloy. To meet the conditions of existing fierce competition, increased production per man or per machine, improved labour-saving devices and making a variety of steels have received attention. Necessity has involved this to such an extent that steel, malleable and grey iron may be produced in the same melting furnace, so reducing overhead charges and keeping the staffs together.

Malleable Castings.

This is more or less a pathetic situation. Steel pressings, forgings, small steel castings, zinc die castings and light alloy castings have proved a serious competitor from a price angle, and, more important, from a delivery standpoint. The magnificent, costly tunnel kilns occupy floor space that might be used to better advantage. To wait for sufficient business to justify firing these kilns would involve a month's delivery date. Conservation of capital, necessitating a rapid turnover, will not permit this. Hand-to-mouth buying is the outstanding necessity of to-day.

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In an endeavour to meet this requirement and to combat the competition of the pressing, forging and casting, the malleable foundries have developed what they term "higher-strength malleable" and also the short-cycle anneal. This higher-strength material runs lower in carbon than the standard certified malleable, and is held to closer limits of permissible compositional variation.

Short-Cycle Anneal.—A number of different treatments have been developed, but they all involve a heating up rapidly over 910 deg. C., holding at the maximum temperature and slow cooling through the critical range. The ordinary annealing cycle of raising to 830 deg. C., holding for 60 hrs., allowing to cool at the rate of 2 deg. C. per hr. to 645 deg. C., takes in all some 7 to 8 days. Some of the new short cycles are—Heat rapidly to 910 to 925 deg. C.; hold 16 to 20 hrs. and cool quickly to 730 deg. C. From 750 to 675 deg. C. cool at the rate of 4 deg. C. per hr., cool off in air from 675 deg. This takes 37 to 40 hrs. in all. The inventors have in mind producing:—Yield point up to 24.5 tons per sq. in.; ultimate strength up to 44.6 tons per sq. in.; and elongation from 6 to 15 per cent.

Certain proprietary malleable irons have been created, such as, for example, "Jewel Steel" and "Ermalite." The former is not steel but malleable containing a little chromium. The latter is normal analysis malleable. The annealing cycle is:—Heat to 955 deg. C. as rapidly as possible; hold at this temperature until the cementite is dissolved, which takes 20 hrs., and then air-quench to approximately 480 deg. C. Then reheat to 785 deg. C. and hold at this temperature for about 10 hrs. and air-quench again.

Developments are in progress using increased quantities of manganese, from 0.6 to 0.8 per cent., and also some nickel.

Another rapid anneal is to heat to 925 deg. C. and hold at this temperature 12 hrs., cool in the furnace to 785 deg. C.; hold at 785 deg. C. for 1 hr. and cool at the rate of 5 deg. C. per hr. down to 590 deg. C., then air-quench as rapidly as possible. This is supposed to give a malleable iron of association specification in five days instead of eight.

The General Electric Company's quick cycle, which they call a "27-hr. cycle" is:—Heat to 980 deg. C., taking about 11 hrs.; hold 4 hrs. at 980 deg. C.; reduce the temperature of the castings to 740 deg. C. in 4 hrs.; hold at 740 deg. C. for 4 hrs. then drop to 715 deg. C.; hold at 715 deg. C. for 4 hrs. and allow to cool in air. Test-castings are then broken and if the anneal is unsatisfactory the castings are reheated to 800 deg. C. and held at this temperature for some period of time determined by the appearance of the fractured sample. The castings are then reduced to 740 deg. C.; held for 4 hrs.; then dropped to 715 deg. C. and cooled in air as described above. The process is not an unqualified success, and has been criticised.

It will be some time before the malleable foundries will be in a position to make these high-strength irons consistently. Machining, ductility and uniformity have all been lacking, and improvements in these are urgently necessary. Failure of these irons also against steel castings is that many of the steel specifications, particularly the railways, call for a minimum elongation of 22.0 per cent. Successfully to substitute steel castings, the malleable founders will have to give equally good properties, and so far the new high-test malleables have not been able to do this.

Other developments in the malleable foundry include cupola continuous melting and the use of an air furnace for heating and equalising the metal. This system, by the way, necessitates a good tonnage and a conveyor system for pouring. Oil fuel is now being successfully used for air-furnace melting. The triplex system of melting in the cupola, refining in the converter and superheating in the electric furnace is finding favour in some quarters. One unit of the Bracklesberg furnace has been installed, and is being tried out for malleable castings.

The Foundry Industry in Czecho-Slovakia in the Year 1931.

By Prof. Dr. mont. FRANT. PIŠEK (Rector of the University of Brno (Brünn)).

OWING to the universal economic depression, the condition of the Czecho-Slovak iron foundry industry is, generally speaking, deplorable. Up to the half of this year, work was scarce only in the grey-iron foundries attached to engineering factories. The detached cast-iron foundries were, up to July, fairly busy; the pipe foundries were working, for instance, at the same pressure as in 1930. From July, however, the production of the detached iron foundries decreased considerably. The production of the pipe foundries amounted to approximately 75 per cent. of the production of the year 1930. The production of some of the detached iron foundries decreased, at the end of the year, to 60 per cent. and even less of the 1930 production. In consequence of the difficult state of the engineering industry the iron foundries forming part of engineering factories were very badly hit, working short hours with reduced staff.

Czech Production Figures.

This, too, was the cause also of the considerable decrease in the production of steel and non-ferrous castings; especially did the large steel foundries suffer from shortage of orders. Activity in malleable foundries decreased only to a very small extent. The trouble in the Czecho-Slovak iron foundry industry was due, apart from external causes, to the internal condition of the foundry industry. During the years of the flood tide of the market, from 1924 to 1929, just after the deflation, the foundries attached to large engine builders were modernised and extended without proper consideration of the disposal of the output and without limiting themselves to a definite well-thought-out programme. In addition to the extension and modernisation of the older foundries, several new foundries were created, so that by 1929 there were about 325 grey-iron foundries existing in Czecho-Slovakia, which produced during that year approximately 320,000 tons of castings. These foundries are mostly equipped for castings up to a weight of 5 tons. There were nine malleable-iron foundries, which produced about 6,400 tons of castings made up of 5,000 tons of white heart and 1,000 tons of black heart; 10 steel foundries, which produced about 41,000 tons of castings; and approximately 200 non-ferrous foundries, which produced altogether about 5,000 tons of castings of copper-base alloys and 2,000 tons of castings made of aluminium alloys.

PROF. DR. MONT. FRANT. PISEK.

Employment and Equipment.

The foundries of Czecho-Slovakia employed during the year 1929 about 21,000 employees. The equipment included, approximately, 620 cupolas, 10 air furnaces, 11 electric furnaces, 27 open-hearth furnaces and 1 small converter, supplemented by about 400 crucible and oil-fired furnaces.

Altogether there were in Czecho-Slovakia in 1929 approximately 550 foundries, which produced about 360,000 tons of castings, of a total value of about ½-milliard Czecho-Slovak crowns. (£3,000,000 at normal rate of exchange.)

Not even in 1929—the peak year—were all of the Czecho-Slovakian foundries employed to their full capacity, with the exception of the malleable-iron foundries.

Decreasing employment caused a fierce price-war, resulting in the offering of castings under cost price from a section of smaller foundries. The result of this is now being revealed by the act that at the close of last year there were already some foundries very badly hit and financially very weak. Moreover, some of the older ones were entirely stopped and wound up.

Price Cutting and the Remedy.

The depression in the foundry industry was accentuated by the fact that large engineers, possessing modern well-equipped foundries, produced, in order to retain their personnel, all types of castings, including small ones, which did not fit in with their programme or their normal production, which only resulted in an increase of their production costs.

The idea that every small engineering establishment should create its own foundry, which was, during the boom, propagated to such a large extent, has proved to be a serious drawback for these small factories; the present depression is already causing a change of opinions.

The existing trouble, which apparently demands as many victims in the Czecho-Slovakian ironfoundry industry as in that of other countries, will produce a reversal to specialisation of production. In the author's opinion, if a reversal to this industrial specialisation has to take place, then, except for the foundries making large castings attached to engineering firms, there will only exist small specialised foundries, technically and economically equipped for definite lines of castings.

The foundries producing all kinds of castings—the jobbing shops—will not have any reason for their continued existence. Possibly the intense economic depression will force a voluntary agreement on definite production programmes between the foundries and will thereby stop the production of all types of castings by fresh producers, in a small way of business and weak as to capital—a factor which has been decreasing price-levels to a ruinous extent.

Recent Developments in Railway Foundry Practice.

By T. HENRY TURNER, M.Sc. (Chief Chemist and Metallurgist, London & North Eastern Railway).

Introduction.

WORK in the foundries belonging to locomotive builders is reported to have been sadly curtailed during the recent abnormal and world-wide trade depression. Main line railways' foundries have nevertheless been kept going steadily, although they, too, have had staff reduction and short time working forced upon them by the need for economies. Castings made or bought by the railway companies in the United Kingdom are estimated to cost upwards of a million pounds per annum, whilst castings used on foreign and colonial railways must cost many million pounds each year, despite the recent decrease in traffic.

Railways in various parts of the world exhibit diverse policies as regards foundry work. Owing, probably to the fact that when railways were developed in this country, efficient foundries for the production of the castings they required were not in existence, most of the larger railway companies set up their own cast-iron and brass and bronze foundries. On the Continent and in America, on the other hand, where railway development was, generally speaking, subsequent to that in this country, there now appear to be relatively fewer railway foundries, and a greater proportion of their stock is built by outside producers.

At the time of the amalgamation of the British railways into the present four large main line groups it was not regarded as advisable to close down many of the foundries. The existence of these foundry buildings has since then precluded the construction of new and larger mass production foundries. There are, therefore, still about 40 owned by the main line railways and working entirely for their own domestic requirements. They do not make, by any means, all the castings necessary, and many are still purchased from outside producers.

Although concentration of railway foundry work into new and impressively large and modern foundries has not taken place, railway foundry practice, being based on large output and long tradition, is in most cases extremely good. Chairs, brake blocks and other products requiring relatively little strength, and having considerable mass, are manufactured extraordinarily cheaply. Steam cylinders, piston-valve cylinders and valve liners are produced in better quality iron, with extremely good wearing properties.

Forgings and castings compete with one another in railway engineering as in other branches of engineering, and from time to time castings are able to replace forgings, this being typically the case in America where the bar and plate locomotive frames have been largely superseded in recent designs by cast steel frames made in plain carbon, chrome-vanadium and nickel steels, all of which varieties of cast steel have been used in recent years.

Steel Castings.

As much as 34 per cent. by weight of many engines just about to go into production for one of the American railroads is made from cast steel, according to figures kindly given to me by the president of the General Steel Castings Corporation. The proportion of cast steel in the tender is even higher, amounting to 47 per cent. by weight, or in the aggregate, engine and tender, 38 per cent. is of cast steel. No British steel foundry has seriously encouraged the railway mechanical engineers of this country to follow this American example.

The most striking foundry developments in recent years have been in the field of steel castings for railway carriage end frames, bogie frames, the side members of locomotive frames, and, finally, for huge locomotive frames, which include the side frames, all cross members and the steam and valve cylinders, in one single monobloc casting.

The largest of these cast steel frames, shown in Fig. 1, over 60 ft. long and weighing more than 35 tons, was made for a Union Pacific 4-12-2 type locomotive. So popular has this method of

MR. T. HENRY TURNER.

construction become in the United States of America that the above firm of steel founders, which was organised in 1928 and absorbed the well-known Commonwealth Steel Company, now have on order no less than 1,157 cast-steel locomotive frames and 1,217 cast-steel solid-bottom tender frames. Moreover, some forty-five frames of this type have been exported for use on Australian locomotives.

One reason given for the introduction of cast-steel frames in America is that cast steel is said to have proved much more resistant to corrosion than forged steel. This might be due, in part, to a protective coating resulting from the siliceous moulding sand fusing into the surface of the steel.

The reduction in maintenance costs of the cast-steel frame, as compared with the bolted frame, is said to have resulted in the fact that one American railroad is now considering the application of cast-steel beds to replace built-up frames on engines not yet five years old, as the maintenance saving entailed on general shopping may be upwards of £500 per engine. These figures are not, of course, applicable to present European conditions, but they do show the way in which American steel foundrymen have been able to assist in railway work. Cast-steel bogie frames have been used by manufacturers in this country, mainly in carriages built for export.

Wheels and Wheel Centres.

The use of chilled-iron wheels, as used in America, is prohibited in England, but cast-steel wheels have become of greater interest since the introduction in this country of the centrifugal casting process for these articles. As regards "Davis" centrifugally cast-steel wheels, although the process used is substantially the same as in the past, the analysis and heat-treatment now employed result in a special type of wheel for use under heavily-braked rolling-stock, such as goods brake vans. It is claimed for the new centrifugally cast steel that it has the property of resisting the thermal effects due to braking and so gives increased life as compared with other types, but so far this has not been shown in extended service.

Messrs. T. Firth & John Brown, Limited, who manufacture both the standard water-quenched Davis wheel and the special-analysis Davis wheel referred to above, state that the injection of the alloying elements into the tyre is carried out by air pressure controlled to one-fifth of a second, thus ensuring extreme similarity of composition in the wheels so made. The alloying elements are thus added to the tread portion of the tyres and the back of the tyre and wheel centre remain unalloyed. Steel castings are used for the centres of locomotive driving wheels, and the method generally employed in their manufacture appears to have undergone no substantial change, with the exception that lighter wheel centres of higher tensile steel are now offered. Considerable improvement has taken place in the lay-out and equipment of the foundries producing these articles. It is the practice in this country to use a rolled tyre on these cast-steel wheel centres.

Chairs and Sleepers.

The whole question of the manufacture and use of steel railway sleepers in this country was recently discussed by Mr. R. Carpmael, M.I.Mech.E., in a Paper read to the Institution of Mechanical Engineers, during the discussion of which he stated that the present 95 miles of G.K.N. steel sleepers on the Great Western Railway would be increased this year by a further 45 miles. In this type of sleeper, the foundryman has, by modern methods, been able to retain the cast-iron chair. This is the composite sleeper introduced, after considerable experiment, by Messrs. Guest, Keen & Nettlefold, Limited, for use with the British Standard bull-headed rail. It makes use of the ordinary standard chair, machine moulded and cast into place, so that no holes are left in the finished unit, sleeper-cum-chairs. In their production, the pattern is mounted on a former plate, the exact shape of the sleeper, the sleepers are set to jig in the mould, and both chairs are cast at the same time, one from either side of the conveyor, which carries the boxes. Mechanical handling is used for the sand throughout, and the output of the conveyor is 400 complete sleepers per day. Sleepers of this kind are now on test by all the main line railways in this country and will be watched with interest, especially as it is uncertain how far steel sleepers will be damaged in the case of minor derailments.

Very few railway foundries make chairs on machines; hand methods have become so simplified and so low in cost that it is very doubtful whether it would be economical to use machines for this purpose, in their existing foundries. The Stanton Ironworks and the Tees Iron Works have, however, both manufactured railway chairs during recent years by means of mechanically-operated foundries. The latter firm installed an experimental plant only a year or two ago, to eliminate as much as possible the man-handling of moulding boxes and sand. Apparently this plant has proved very satisfac-

tory, the following being its method of operation. The drags, after being rammed on the moulding machine and the pattern drawn, are placed on a Herbert Morris gravity roller conveyor; after travelling a short distance the top box is placed in position on the drag, and the box then travels to a horizontal portion of the conveyor, where it automatically stops and is then poured. From this position it travels to the end of the conveyor where it is stripped on a grate over the sand-elevator boot. The drag is then transferred to a second conveyor, on which it travels back to the moulding machine. The top box is similarly placed on a third runway, which returns it to the top rammer. All handling of boxes is thus reduced to a minimum. The sand is elevated into a rotary sand conveyor and cooler, and is delivered by this machine to the moulding machine. It is claimed that by the use of cold sand, facing sand is cut down to a minimum, and the chairs are stronger and of a better finish.

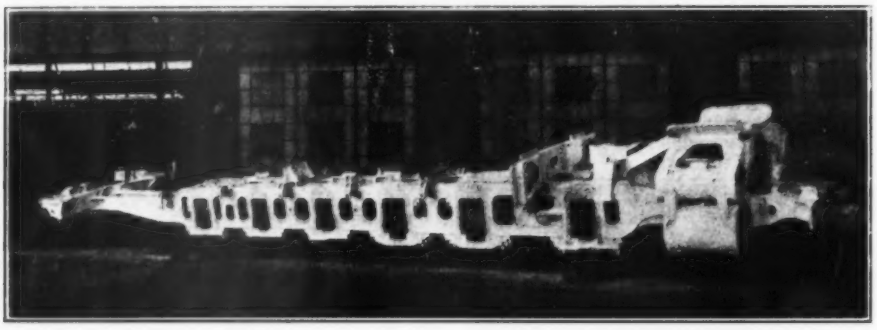


Fig. 1.—Monobloc Steel Casting of Frame and Cylinder for a Massive Three-cylinder Locomotive.

Experience with these chairs shows that they certainly have a good appearance and rarely give the inspector trouble as regards gauging. Despite the large number of chairs manufactured in railway foundries, many thousands are still purchased from outside producers each year.

Cast-Iron Melting Practice.

The large tonnage of cast iron for railway chairs, brake blocks and firebars makes railway-foundry practice somewhat different from that of many other foundries, as railway foundries have a very regular and uniform supply of cast-iron scrap. They are called upon, however, to turn out high-class and very complicated cylinder castings, and the large variety of general engineering castings required by one or other of their departments. Cast iron is still being melted in cupolas in all the British railway foundries; modifications have recently been made to several of the cupolas of the main-line railways. A unique feature, although not a recent modification, is to be seen in the L.N.E.R. foundry at their Gorton works, where each of the four 42-in. cupolas have two tap-holes, one on each side, so that tapping can be done either to the general casting side of the foundry or to the plate shop, where railway chairs and brake blocks are cast. This use of two tap-holes necessitates the employment of slag bogies, which, although in general use for many other furnaces, are not commonly seen for cupolas. The result is a very tidy set of furnaces around which to work. The pouring of a large three-cylinder casting in this foundry is shown in Fig. 2.

Since the amalgamation of the numerous constituent companies, cylinder mixtures have been standardised in the case of all the L.N.E.R. foundries, a percentage of refined pig-iron of known composition being used. No steel additions are made to any high-duty castings, but firebars do have a proportion of steel scrap in them. A considerable number of special-mixture firebars have been tested from time to time under service conditions, but the common bar, as made in railway foundries with a steel addition to the metal, is giving remarkably good service. These common firebars are produced very cheaply, and a set of them has a life of upwards of 30,000 miles under normal conditions.

Cylinders and Liners.

The design and manufacture of locomotive cylinders has always presented a difficult technical problem to locomotive engineers. The improvement in foundry and machine-shop equipment now permits the production of monobloc castings which include three steam cylinders and three piston-valve cylinders, together with all the necessary steam passages and anchorage points. The placing of larger-diameter cylinders outside the main frame of the locomotive and modifications in valve gears have resulted in entirely new types of cylinder castings.

Castings of the three-cylinder type used on recent L.N.E.R. locomotives weigh between four and five tons, and in Fig. 3 one may obtain an impression of their size in comparison with the men employed in fettling the one photographed. A complication in this design is somewhat hidden from view by the centre fettler standing in front of the middle cylinder. This cylinder is not parallel with the two outside cylinders, but inclined downwards at an appreciable angle.

Modern railway practice coincides with other engineering practice in so far that cylinder liners are becoming increasingly popular. The life of locomotive cylinders is so long that it does not appear necessary to make much change in the metal used for them unless lightness be required. Alloy cast iron has been employed for cylinder and piston valve liners and piston rings, but the increased cost of these additions has, up to the present, precluded their use in the case of cylinders.

Non-Ferrous Metals.

The railway companies own more brass foundries than iron foundries, and in brass foundries belonging to three of the main line companies many of the pot fires have been replaced during the last year or two by modern reverbatory furnaces, and, according to report, these are standing up to many thousands of melts without re-lining.

Fig. 2.—Pouring a Three-cylinder Monobloc Casting in the L.N.E.R. Ironfoundry at Gorton.

Fig. 3.—Fettling a Cast-iron Three-cylinder Monobloc Casting for an L.N.E.R. Locomotive.

The types of alloy called for are varied. Phosphor-bronzes are used for slide and regulator valves as well as for axle boxes and various kinds of liners and insertion brasses and bushes. Certain of the latter are made in strong leaded bronzes, as are also some big and little end bushes. A softer leaded bronze is used in large quantities for general steam and boiler mountings. Admiralty gun-metal is also cast for valve rod bushes, glands and other such parts. Pipe-flanges are cast in brazing metal.

The peculiarity of railway brass foundry work is that it offers a means of using up scrap firebox material, and arsenical copper has therefore come to be spoken of in these foundries as virgin

copper. The gradual reduction in the number of non-ferrous alloys since the amalgamation of the railway companies has presented difficulty on account of the length of time which practical trials entail. An endeavour has naturally been made, and is still being made, to eliminate less satisfactory mixtures, and to standardise on those which have given the best service in practice. Almost every locomotive works has its own brass foundry, and it has not yet proved possible to rationalise this section of the work. The casting of bearing metals and packing metals is a routine part of railway engineering, but up to the present no railway has taken up the casting of light alloys in the manner commonly seen in automobile practice.

Conclusion.

In conclusion, a review of recent developments in railway foundries shows that they are wisely conservative, but by no means unenterprising. The officers of railway foundries are as keen and enterprising as any others. Up to the present little has been done in respect of mechanisation. The conditions preclude this as it depends upon specialisation of production, and a completely specialised foundry could not work advantageously for businesses so scattered in operation as are the present-day large main line companies. Inconvenience in delivery may easily offset advantages gained by centrallisation, and manufacture judiciously distributed reduces unnecessary haulage. The writer gladly takes this opportunity of thanking many friends for information given him during the preparation of the above review.

The Italian Steel Foundry Industry in 1931.

By Dr. Ing. GUIDO VANZETTI (Fonderia Milanese di Acciaio Vanzetti).

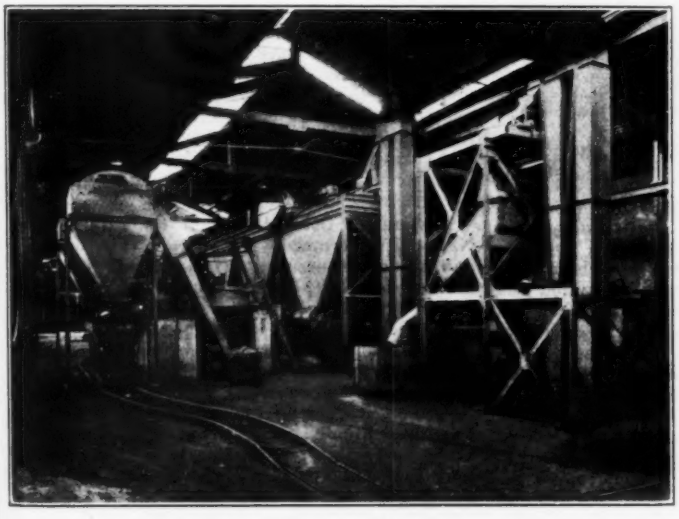
ITALY is generally considered to be a purely agricultural country, with a few industrial concerns concentrated in the north. Actually, if each nation produced only what was best suited to its natural and economic conditions—the climate, on the one hand, and the almost total absence of coal and scarcity of iron on the other—such conditions would confirm this opinion of Italy. On the contrary, one of the characteristics of our time, which is so uncertain and unsettled, is that each nation desires to become independent. It wishes to produce itself even those commodities which it could more economically import from abroad in exchange for other products which it is better placed than other nations to produce. Profound examination, however, shows that a country like Italy should have its iron and steel industry.

Altogether, for the melting of ingots and castings, there are in Italy about 100 electric furnaces of a capacity varying from 1,000 lbs. to 25 tons. The electric furnace is certainly ideal for a steel foundry where production does not allow the use of an open-hearth Martin furnace of 5 to 8 tons or more. It permits the attainment of better-quality products and gives a superior yield to that of other furnaces. Moreover, in Italy there is the important factor that it involves to the highest degree the use of national hydro-electrical energy in substitution of that given by imported fuel. In addition, the use of scrap steel as raw material is cheaper, as this is exempt from duty.

The steel-castings market may be said to be closed as far as Italy is concerned. Experts are almost nil and imports are now reduced to about

It is certain that in this struggle a few foundries will have to go under. Undoubtedly the near future will see the disappearance of a few of those which are not connected either with a machine shop or a shipbuilding yard, where they would have an ensured outlet for their production. There will also be a disappearance of those which are not entirely *sound*, that is, those which have not been brought up to date in the matter of plant; those which, by adhering to empirical methods of manufacture, have not been able to make a better product whilst simultaneously reducing the cost of production to a minimum.

Here also it can be seen that in Italy there are limits to the possibility of the rationalisation of the steel-foundry plants involving the latest conceptions; the limited production spread



SAND-PREPARING PLANT AT THE MILAN STEEL FOUNDRY.

ANOTHER VIEW OF THE SAND-PREPARING PLANT AT THE MILAN STEEL FOUNDRY.

The steel-castings foundry may be said to have begun its development in Italy during the last decade of the last century. At first converters were used; in fact, in 1888 a Milan foundry produced castings weighing several tons, using two small Robert converters of one ton capacity. After this there came the open-hearth furnace—more economic to run than the converter—which almost completely displace the latter. In 1904 the first Stassano electric furnace was placed in active industrial service. When war broke out it gave considerable impetus to the production of electric steel, especially on account of the absence of coal in Italy and the difficulty of obtaining supplies during the war period. It may be said that to-day steel castings are melted in Italy almost exclusively in electric furnaces.

a fortieth part of the production. The production of steel castings, which in Italy for several years was about 50,000 tons, is presumed to have dropped this year by about 30 per cent. This is due in a great measure to the large decrease in orders by the State Railways this year, on account of the reduced volume of traffic.

If we take into consideration that in 1913 the only three or four steel foundries operating in Italy together produced only 16,000 tons of castings, and that to-day the production is only just above double this figure, whereas there are now twenty steel foundries in Italy, it will at once become evident that there is a great disparity between plants and production.

The struggle between the various competitors due to this discrepancy caused a drop in prices to levels at times quite unremunerative.

over the different steel foundries is so varied that it is not possible to organise repetition work to any real extent.

A little has been noticed during the present year, perhaps on account of the conditions originating from this state of things, and in great part on account of willingness on the part of some manufacturers, a certain desire to make advances, a wish amongst the different foundrymen to co-operate in their mutual interest.

The formation of the Foundry Group both in the National Fascist Association of Italian Iron and Steel Manufacturers and in the National Fascist Association of Engineering and Allied Trades (which included respectively the steel foundries and cast-iron and other metal foun-

(*Concluded on next page.*)

The Non-Ferrous Metals in 1931.

(By Our Metal Exchange Correspondent.)

IN reviewing the year 1930, it was necessary to refer to a succession of falling values, and hopes were expressed that 1931 would see a recovery made. For a month or two there certainly seemed to be a chance that existing values would at least be held, but the ever-growing difficulties in the German financial situation and the decline in business activity in the United States made it obvious before long that commodity prices were destined for a further decline. By the early days of June copper and spelter had set up new low records for all time, while lead and tin were quoted a long way below the level at which the year opened, and there was every indication that the bottom had not been reached, for demand was dwindling day by day. Then came President Hoover's suggested moratorium for war debts, and there was a burst of optimism which raised prices very rapidly and well beyond the point justified by the amount of support conceded by consumers, although this was not inconsiderable.

Low Price Levels.

Objections raised by France pricked the bubble of super-optimism; markets very quickly degenerated and assumed a dull and uneventful course, with the tendency downwards. Copper, particularly, was weak, and by about mid-September a fresh low record had been made, both in U.S. currency and sterling. Then came the most startling event of the year in the shape of Britain's abandonment of the gold standard, with an immediate rearrangement of sterling equivalents, since when the daily fluctuations of the external value of the £ have constituted most of the problem confronting buyers of non-ferrous metals.

Prominence has been given to the two main factors operating last year to influence the sterling values of metals, but other influences of importance were the political upheaval in this country during the late summer and autumn, the collapse of industrial activity in America and the extremely unstable conditions in Germany. More recently, the tariff question has come to the fore. To speak truly, the situation in these opening days of 1932 is somewhat chaotic, but if a serious collapse in any direction can be avoided, then issues may clarify and some progress towards the establishment of a saner condition of things be achieved before the year is finished.

COPPER.

The year 1930 ended with a much firmer tendency in copper values, for on December 30 the Copper Exporters, Incorporated, advanced their price to 10.80 cents c.i.f., with a sterling equivalent of £49 17s. 6d. The movement was generally attributed to a desire on the part of the producers to raise values for balance-sheet purposes. Demand from consumers was certainly not good, but the customary New Year optimism served to steady the market for a few days, until forcing tactics by Customs smelters in New York compelled the American organisation to reduce its selling level. Early in January the December statistics were made available, and disclosed a decrease in stocks of about 9,000 short tons, bringing the total for refined metal down to 367,000 and of blister copper to about 220,000 short tons. Domestic deliveries were returned at 70,000 tons and exports, which showed a drop of 6,000 tons on November, at 39,000 short tons. The alarming increase in reserves of copper last year has such a marked bearing on the history of the metal during the twelve months that it has been thought well to give details of the statistics for quarterly periods as far as available. The figures are shown in short tons of 2,000 lbs. and are in accordance with the official releases:—

	Dec. 31, 1930.	March 31, 1931.	June 30, 1931.	Sept. 30, 1931.
Refined production	106,400	102,000	98,000	86,700
Domestic deliveries ..	70,000	75,000	50,000	40,500
Export shipments..	39,000	36,800	33,000	22,100
Refined stocks	367,000	354,000	413,000	480,000
Blister stocks	220,000	198,000	187,000	177,500

The deterioration in the statistical position after the first quarter of the year is apparent, and, although no official figures have been available since September 30, it is estimated that between that date and the end of the year stocks have been further added to by anything from 50,000 to 70,000 short tons, the grand total at the end of 1931, therefore, being within measurable distance of three-quarters of a million tons. Attention is drawn to the fact that these figures cover North and South America only, and that a reduction of almost exactly 30 per cent. in the output of refined copper had been achieved by September last, such curtailment, however, being more than offset by the shrinkage of over 40 per cent. in deliveries to home and foreign users.

Decline in Consumption.

Broadly speaking the outlook for copper was not considered to be unfavourable during the first quarter of last year, and it will be noted from the figures quoted above that stocks at the end of March showed a decrease on the total with which the year began. From April onwards, however, there was a steady decline in the rate of consumption, and increasing evidence of new production in Canada and Africa. During May, when the Exporters' price stood at 9.27½ cents per lb. c.i.f., the quotation ruling in New York was 8½ cents, and there were rumours of internal dissension in the ranks of the Exporters, a state of affairs which was ultimately straightened out. Just prior to Mr. Hoover's announcement of a moratorium at the end of June the Copper Exporters were quoting 8.27½ cents per lb., or £38 5s. in sterling, but the overflow of optimism which followed the suggestion put forward by the President of the United States compelled a very rapid advance in values. Due mainly to the Association's scheme of rationing daily sales, its price for electro was forced up to £42 17s. 6d., but difficulties raised by France damped enthusiasm, and within a fortnight the quotation was back again to £38 7s. 6d. Looking back, it is easy to realise that much harm was caused by this interruption to the inevitable decline in copper values, for users filled up with what quickly proved to be overpriced metal, much of it in anticipation of orders which never materialised.

Copper values again began their downward drift, the situation being dominated as previously by Customs smelters and second-hands, while the influence of the Exporters' Association lessened almost day by day. On September 14 the quotation for standard copper fell below £30, but, although some resistance developed, the landslide continued, until on September 18 the price stood at £27 15s. cash and £28 10s. three months, wire bars being listed at £33 10s. and the Exporters' sterling equivalent of 7½ cents being £34 17s. 6d. At this time there was much talk of output curtailment, and it was reported that a meeting of world interests would be held in New York during October. Such was the situation when, with dramatic suddenness, came the announcement that Britain had gone off the gold standard. September 21 saw an advance of £5 in standard copper and £3 10s. in wire bars, and by September 25 the warrant market was quoted at £36 15s., three months, and wire bars £44. Business with consumers ceased almost entirely when it was announced that the Exporters were prepared to quote only in American currency, but within a few days second-hands were offering in sterling and taking all the orders available.

Curtailment Negotiations.

The end of October brought the return of a National Government to power in this country, and the commencement of the curtailment conference in New York, upon the outcome of which a good deal of optimism was expressed in the early stages. During this period the London market suffered many ups and downs, due to the erratic movements of the dollar exchange and the conflicting rumours cabled from New York regarding the outcome of the negotiations. Finally, after about three weeks of acute uncertainty, it became known in London that the conference had failed, and standard was heavily sold in consequence, while the Exporters brought their price down to 7 cents c.i.f. Hard on the heels of this came the announcement that the Phelps Dodge Copper Corporation had given notice of withdrawal from the Association, and this was immediately interpreted as the beginning of the end as far as the Exporters' Association was concerned. The market slumped, but recovered within twenty-four hours on a report that Katanga had intimated their willingness to fall into line on the curtailment proposals. Since then discussions have been renewed in New York, and, with business at a low ebb, values of copper on this side have been almost entirely under the influence of the dollar exchange, although, shortly before Christmas, an increase of half a cent. was made by the Exporters, which raised their quotation to 7.50 cents. c.i.f. This was apparently prompted by the announcement of the curtailment scheme, which provides for a cut in some 90 per cent. of the world's pro-

(*Concluded on page* 32.)

The Italian Steel Foundry Industry in 1931.

(*Concluded from previous page.*)

dries) was a first sign of this necessity of coming to a proper understanding.

In particular these associations propose to establish and maintain amongst their members constant relations and contact by meetings, conferences, congresses, etc.; to promote projects and agreements of a technical and scientific character with the object of organising and rendering the production more economic; to patronise initiative for the improvement of the professional education of the staff; to promote agreements tending to facilitate and govern supplies, modes of purchase, inspection and passing of the necessary materials; to study the adoption of rational ideas and uniformity in methods of the calculation of costs of production; to study and encourage, in fact, all that which may prove to be of interest and use to the foundry industry.

In conclusion, I desire to mention that for the first time in Italy this year there were organised an International Foundry Exhibition and Congress. The presence of as many as forty British foundrymen, who were able to see for themselves the condition of the foundry industry in Italy in 1931, certainly contributed to the success of this manifestation.

Recent Developments in Aluminium Founding.

By Prof. D. HANSON, D.Sc. (Professor of Metallurgy, The University, Birmingham).

EVERY foundryman knows that it is by no means a simple matter to produce, in any metal, a casting that shall be entirely sound and free from internal defects of all kinds, and he must exercise his skill and ingenuity in a constant struggle to eliminate or reduce to a minimum imperfections of all kinds in his product. From the point of view of internal soundness, aluminium alloys must be regarded as amongst the most difficult that the foundryman is called upon to handle; to counterbalance a conveniently low melting point, aluminium possesses a high heat capacity, a large solidification shrinkage, and a great capacity for absorbing gas, while its tendency to form continuous films of oxide introduces serious foundry difficulties.

Prevention of Pinholes.

Within recent years a great deal of attention has been given to the causes and methods of prevention of "pinholes," those small, rather irregular cavities which are frequently seen particularly in aluminium-alloy sand castings, and give rise to what is sometimes known as "speckled metal." They may vary in size from ½ in. dia. to minute holes visible only under the microscope, and although they are most commonly found in sand castings, defects of a like nature are much more common in chill castings than is usually supposed. In bad cases they may lead to porosity; in any event, they indicate some degree of mechanical weakness, and in particular are associated with low ductility, and, in cases where strength considerations are not important, they may be objectionable because they give a bad appearance to a finished surface. The development of high-strength aluminium-alloy castings by heat-treatment has drawn particular attention to this type of defect, since it has been found that the attainment of the best properties in the heat-treated alloy is only possible if the casting is initially sound. The standard required in high-grade aluminium castings has become very high within recent years, largely owing to their use in the manufacture of aircraft, castings for which are required to be free from pinholes. This stringency has led to a higher standard in other directions and has served to concentrate attention on the difficult problem of eliminating this defect.

Deleterious Effect of Hydrogen and Water Vapour.

Some of the causes of pinholes have been appreciated for a long time, and a Paper by Budgen in the "Journal of the Institute of Metals, 1929, No. 2," summarises in an excellent manner the state of knowledge at that time. It is fairly generally recognised that they are principally due to the evolution of gas during solidification, particularly during the later stages when it is unable to escape from the partially solid metal. It has long been known that aluminium readily absorbs gases from the atmosphere of most industrial furnaces, and that the rate of absorption is particularly serious if the molten alloy is overheated. It is, however, only within the last two years that the nature of this gas absorption has been understood. The most important gases in this connection appear to be hydrogen and water vapour. Claus was the first to show that if molten aluminium be exposed to the action of water vapour, castings produced from such metal contained a serious number of pinholes. I. G. Slater and the writer made the same discovery quite independently in the course of an investigation carried out for the British Non-Ferrous Metals Research Association. In our experiments virgin aluminium and various alloys were exposed to the action of steam in an electric furnace, in some cases by passing steam into the furnace and in other cases by bubbling it through the molten metal. In all instances this treatment resulted in large numbers of pinholes when the metal was subsequently cast in sand. Table I summarises a few of these experiments.

PROF. D. HANSON, D.Sc.

Choice of Fuel and Furnace.

The discovery of the importance of water vapour is very important since this gas is present to a greater or less degree in all furnace atmospheres; it is a product of the combustion of gas, oil or coal, and may be present in large amounts in furnaces using any one of these fuels. It is, in fact, difficult to prevent some reaction, involving absorption of hydrogen, when any aluminium alloy is melted in gas, oil or coal-fired furnaces, and the rate of absorption becomes specially rapid when the temperature exceeds 700 deg. C.; it is therefore very important that the period of exposure of the molten metal in such furnaces should be as short as possible, and that the temperature should be kept as low as is consistent with satisfactory pouring Coke and electric furnaces are much superior from this point of view, since water vapour is not present in large quantities, unless, of course, wet coke be used. Experience is now showing that furnaces of this type are much more satisfactory for aluminium alloy melting if pinhole defects are to be avoided. At the same time, it is impossible to avoid the presence of some water vapour in contact with the molten aluminium even in these furnaces, since moisture is always present to some extent in the atmosphere. The amount, however, is not usually sufficient to cause serious trouble provided a reasonable degree of foundry control is exercised.

It is obvious that the best foundry methods will be unavailing if the solid metal charged into the furnace already contains serious amounts of gas. There is a wide-spread belief among aluminium foundrymen that ingot aluminium varies greatly in its gas content, and that much of the trouble experienced in the foundry is due to this cause. We can now state that there is much justification for this belief. Slater and the writer have carried out experiments on this problem which have revealed a hitherto unsuspected cause of unsoundness in aluminium alloys. Aluminium is a reactive metal, and a consideration of its chemical properties leads to the conclusion that it is capable of reacting with water at ordinary temperatures; the reason why this action does not normally take place is that the aluminium is covered by a thin protective film which isolates it chemically from its surroundings. If, however, it be exposed to such conditions as would lead to a certain amount of corrosion, the chemical isolation of the metal is broken down. We have now found that, if solid aluminium or aluminium alloy is exposed to varying degrees of humidity, corrosion is started which is revealed by the formation of small incrustations of corrosion product on the surface; when such aluminium is melted and cast the resultant casting contain pinholes, and if the metal were initially gas-free the degree of pinholing is the greater the more severe the conditions of exposure to moisture.

Storage Conditions Affect Ingots.

The action is not usually a quick one and may take some months before deterioration of the metal is serious. Moreover, different alloys and even different batches of aluminium vary in the rate at which they deteriorate; nevertheless we have yet failed to find any aluminium or alloy that was not definitely affected by 6 months' exposure to corrosive conditions. The silicon alloy and Y-alloy deteriorated rather rapidly, whereas some batches of ingot aluminium deteriorated quite slowly. On the other hand, check experiments made with the same metal maintained in a dry atmosphere, or under conditions of good storage in the laboratory showed no deterioration. It is, therefore, established that, when solid aluminium alloy is exposed to conditions of bad storage leading to exposure to moisture, the metal can deteriorate in a manner that will give rise to porosity when it is re-melted and cast.

TABLE I.—*Effect on Virgin Aluminium and Various Alloys of Exposure to Action of Steam.*

Material.	Treatment of Molten Metal.	Density.	Appearance.
3L11	None. Standard test casting	2.771	Moderate.
3L11	Atmosphere of steam for 1 hr.	2.728	Very bad.
3L11	Brisk stream of steam bubbled in for 1 hr.	2.221	Very bad.
3L11	Brisk stream of steam bubbled in for 3 min.	2.690	Very bad.
Virgin aluminium ingot ..	None. Standard test casting	2.673	Practically sound.
Virgin aluminium ingot ..	Brisk stream of steam bubbled in for 3 min.	2.469	Very bad.
2L5	None. Standard test casting	2.934	Moderate.
2L5	Brisk stream of steam bubbled in for 3 min.	2.788	Very bad.

The exact mechanism of this deterioration has not yet been completely solved. Two factors at least are of importance; in the first place, the products of corrosion are always hydrated and contain a certain amount of moisture, and if these are melted with the metal they may give rise to hydrogen absorption through reaction of the moisture with the molten aluminium; on the other hand, experiments in which the products of corrosion were removed before the metal was re-melted show also that some of the gas, probably the largest portion, is actually held by the solid metal itself.

Various practical conclusions at once arise as a result of this new knowledge. It is quite clear that aluminium ingots must be protected from prolonged exposure to humid conditions if difficulties in founding are to be avoided, and this may require a modification in the conditions of storage, which are very unsatisfactory in many foundries. A damp humid atmosphere must be avoided, particularly when stocks are to be held for long periods, and ingots should under no circumstances be stored outside where they are exposed to the weather. The writer has no doubt that much of the gas in commercial aluminium alloys is due to exposure of the solid metal to moisture between the time when it leaves the producer's furnace and when it is finally melted in the foundry; that is, during transport and in store. Gas so introduced may remain in the metal in sufficient quantities to give defective castings when it is re-melted even under the best melting conditions, as, for example, in electric furnaces.

The use of scrap metal requires very careful consideration. Scrap arising in any foundry can be stored and maintained in a suitable manner in that foundry, but many works are obliged to use miscellaneous scrap from outside sources, much of which has been either in service or exposed under injurious conditions; usually it is corroded to a greater or less degree. Such scrap is likely to contain much gas, and should be treated accordingly either by being subjected to a de-gassing process or by being reserved for work in which trouble in this course is not likely to be experienced, such as chill castings or very thin sections.

Clearly the ideal method for avoiding pinholes is to use gas-free metal, and to melt it under the best possible conditions, as, for example, in coke or electric furnaces. Given ingots of good quality, it is a matter of no great difficulty to produce pinhole-free castings in either of these types of furnace. At the same time, the best of metal can be ruined by bad foundry practice and unsuitable melting conditions.

Palliatives Available.

In practice, it is not always possible to attain this ideal, and palliative measures may be necessary, particularly when large amounts of scrap or metal of doubtful origin are being handled. Various processes have been suggested for removing gas from aluminium alloys. Archbutt discovered that slow solidification gave the opportunity for much gas to escape, and that, on re-melting, the amount of pinholing was greatly reduced. This method is undoubtedly effective in removing a large amount of gas from defective metal; the principal disadvantages are the time involved and the difficulty in re-melting sufficiently rapidly to avoid further contamination. Rosenhain and Archbutt later suggested bubbling nitrogen through the molten metal as an effective way of preventing pinholes, while Tullis has recommended the use of chlorine and boron trichloride. None of these methods has proved completely satisfactory in service, particularly where large quantities of metal have to be dealt with. More recently, Rosenhain, Grogan and Schofield have used titanium tetrachloride and some other volatile chlorides for the same purpose. Boron trichloride and titanium tetrachloride have the advantages that they greatly refine the grain size; this is an advantage even when gas removal is not complete, since it refines the size of the pinholes along with the general structure, and produces a better appearance and enhanced mechanical properties. Claus has stated that pinhole-free castings may be obtained if the molten metal is maintained for some time just above its melting point, when most of the gas escapes. Slater and the writer, after investigating a large number of methods, came to the conclusion that the most effective process for gas removal was treatment with a mixture of equal parts of nitrogen and chlorine bubbled through the metal.

Mass of Metal Introduces Difficulties.

The most serious difficulty with all the above forms of treatment is that, to be effective, they must be carried out as close to the melting point as possible, particularly where large quantities of metal are to be treated; for example, treatment with nitrogen or with chlorine are only effective on small melts when carried out in this way, and are of doubtful value when commercial quantities are involved. Methods involving the use of chlorine are difficult to apply in a foundry for obvious reasons, although these difficulties could no doubt be overcome, while the use of titanium tetrachloride, which is possible on a small scale, is difficult in works practice owing to the great volume of fumes evolved. Whilst no satisfactory practical solution has yet been discovered that is capable of universal application, it is nevertheless true that many of the above methods are applicable in special cases when sound castings must be obtained.

While the problem of pinholes has not yet been completely solved, great advances have been made within the last two years, and the nature of the difficulty is far better understood than ever before. A complete solution will clearly involve co-operation between producer and user; in particular, the preservation of the solid metal from deterioration is a question that must seriously be faced.

Foundry Troubles with Gas-free Metal.

There is one other aspect of this problem that should be mentioned. The use of gas-free metal may introduce foundry difficulties not normally experienced with metal of lower quality. The evolution of gas during solidification acts in the opposite sense to solidification shrinkage; gas-free metal will, therefore, have a large volume change on solidification, with the result that draws, internal shrinkage, cracks and similar defects are more likely to occur. The provision of gates and risers, their positions, numbers and size, may, in many cases, require careful reconsideration. Indeed, instances have already occurred in which founders, supplied with gas-free metal by the aluminium producer, have been forced to reintroduce some gas by poling with wood, in order to overcome new foundry difficulties of the kind indicated!

Non-Ferrous Metals in 1931.

(*Concluded from page* 30.)

duction to 26 per cent. of capacity. Should the price advance to 12 cents, then the scheme lapses, or, again, if stocks have not fallen to a tonnage equal to the total of the previous four months' output by December 31, 1932, then any member may withdraw on giving thirty days' notice. On the whole the plan appears to be rather vulnerable and the market has not taken very kindly to it.

TIN.

The year opened with the price of tin at £116 12s. 6d. cash and £118 2s. 6d. three months, the market being nervous and susceptible to reports concerning the progress of negotiations towards completion of the scheme for cutting down production and curtailing shipments of the metal. Fairly wide fluctuations were seen, but any marked fall was held in check by hopes of a check to production, until in March it was announced that the various governments concerned had given their sanction and the scheme became a *fait accompli*. The quotation kept at around £120 until April, but the realisation that consumption was still falling while stocks were increasing brought values down to £103 early in May, while a month later cash stood at £100 12s. 6d. The Hoover announcement brought a quick rise to £118 10s., but a reaction followed, and tin was quoted at £111 2s. 6d. just prior to the abandonment of the gold standard. The effect of this was, of course, immediate, and prices appreciated on the London market to the extent of £10 per ton.

Early in September came the announcement that a Tin Pool had been formed which would hold off the market some thousands of tons of tin until such time as the price reached £150 per ton, and that only 5 per cent. of this reserve would be offered for sale when the £150 level had remained in force for one month. At the same time, there was a tightening-up of control of output and more than a hint that plans for putting tin on its feet again would be rigidly enforced. During the weeks which followed, European consumption showed some improvement, but in the United States demand fell away, and deliveries there in November were only 3,500 tons. Early in December, however, the market improved and passed £140, on the announcement that the International Tin Committee had recommended an additional 15,000-tons reduction in output to begin on January 1, 1932, and at the same time it became known that the Pool held nearly 16,000 tons of the metal.

LEAD.

Lead opened last year at £14 5s. spot and £14 7s. 6d. forward, the market bearing quite a steady appearance and demand being moderately good, but realisation that stocks were on the increase created some uneasiness, and in April there was heavy selling on reports of disagreement among producers on the subject of output curtailment. Soon after this, however, a 15 per cent. cut in production was announced, and the market brightened temporarily, but lack of demand dragged values down again, £11 8s. 9d. being touched early in May and £10 7s. 6d. early in June. Recovery followed to £13 11s. 3d. on the Hoover announcement, but, in spite of the grip on the London market maintained by the Lead Pool, the price was back to £10 13s. 9d. by mid-September. Abandonment of the gold standard brought an immediate recovery to £12 12s. 6d., and within a few days there was a further gain to £15 10s. From this point some reaction has been seen, but, with stocks tending to decrease, the tone of the market has been fairly steady, and the outlook is considered to be moderately favourable, many people being of the opinion that lead stands in the soundest position of all the metals.

SPELTER.

The spelter market opened at £13 6s. 3d., and a fairly steady tendency was seen for a time, but poor demand and ever-growing stocks soon brought a downward movement, until on June 3 an absolute low record was set up at £9 13s. 9d. Persistent reports were in circulation during the first six months of the year that the Zinc Cartel was to be re-formed, if possible to include United States production, and, finally, in July, it was announced that the scheme had successfully gone through, America, however, not being included. But the brighter prospects for spelter were outweighed by the general pessimism prevailing, and, although curtailment was on a drastic scale, values drifted downwards, the quotation being £10 7s. 6d. just before the abandonment of the gold standard. Since then the quotations in sterling have naturally improved, and there has been a growing realisation of the merits of the spelter situation, engendered by the knowledge that stocks are falling and that on December 1 last the rate of curtailment was raised to 50 per cent.

Developments in Marine Engineering Foundrywork.

By SUMMERS HUNTER, Jun. (Managing Director, The North Eastern Marine Engineering Company, Limited, Wallsend-on-Tyne).

IN dealing with this subject it is not out of place in the first instance to review the developments which have taken place during the last few years in marine propelling installations, and afterwards to consider the effect of these developments on the work of the foundry. The outstanding feature is probably the rapid progress made by the internal-combustion engine, and Table I below shows very clearly the advance made by this type of engine during recent years.

It will be observed that, whereas in 1923 new motor-driven tonnage comprised 14.4 per cent. of the total, in 1931 the corresponding figure was 57 per cent. In this connection, however, it should be mentioned that the latter part of the above table refers to a period when an abnormal proportion of tanker tonnage was built.

It will be appreciated that as compared with the steam engine, the Diesel engine for marine propulsion has been subject to a more rapid change. The demand for more power from a given weight and space has caused increased attention to be paid to supercharging. The method of utilising the energy of the exhaust gases to drive a turbo-blower, which in turn delivers air to the cylinders at a pressure above the atmosphere, is a very definite advance towards this end.

TABLE I.—*Progress made in Motor-Driven Ships.*

Year.	Total new tonnage.	Steam driven.	Motor driven.	Percentage motor driven.
1923	1,643,181	1,407,181	236,000	14.4
1924	2,247,750	1,821,750	426,000	18.9
1925	2,193,404	1,503,404	690,000	31.5
1926	1,674,977	939,977	735,000	43.9
1927	2,285,679	1,469,394	816,285	35.7
1928	2,699,239	1,522,004	1,177,235	43.6
1929	2,793,210	1,662,735	1,130,475	40.5
1930	2,889,472	1,249,182	1,640,290	56.8
1931	2,079,947	895,787	1,184,160	57.0

The importance of this can be gauged from the comparative figures (Table II) relating to two engines of the same horse-power built by the same firm, one engine of which was suction-charged and the other exhaust-turbo charged.

It will be seen that the size of the cylinders, and consequently of the whole engine, is much less in the case of the exhaust-turbo-charged example, hence the space available for cargo is correspondingly increased.

In the race for efficiency as represented by lower running costs, and in view of the challenge of the Diesel engine, it is natural that development in steam-engine practice, both turbine and reciprocating, should also have taken place. This has proceeded along the lines of increased temperatures and/or pressures and the last few years have seen considerable advances made in these directions. This applies not only to new vessels but also to the conversion of existing engines to the use of superheated steam.

Thus, since 1920, the writer's company has fitted superheat installations in about 100 old vessels in addition to some 300 new ships. It may be added that a new design of superheater, to obtain still higher steam temperatures, has recently been developed in which the heating elements are located in the combustion chamber of the boiler instead of in the smoke tubes.

The above brief review suggests the main directions in which foundrywork has had to develop to keep pace with marine engineering developments, resulting in a demand for the following: (1) Production of castings of metals and alloys having the requisite properties to withstand the high temperatures and pressures encountered in Diesel engines and engines using superheated steam, and (2) the production of the special castings, many of which are very complicated in design, required for Diesel engines.

MR. SUMMERS HUNTER, JUN.

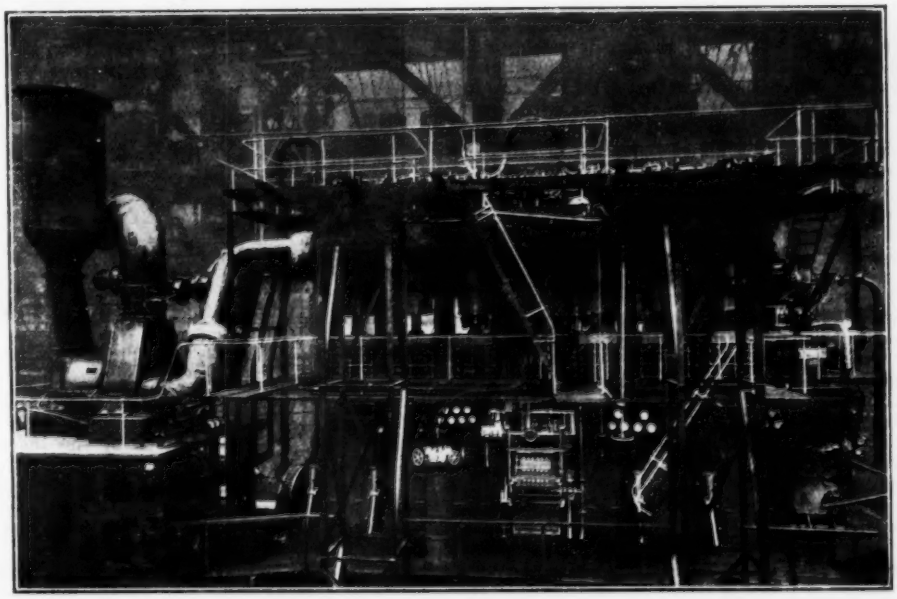
It will be understood that the problems which arose from No. 1 above were of a metallurgical nature, involving the development of higher grades of metals than were previously necessary. Their investigation has resulted in very considerable advances in cast iron having been made and also in the production of certain non-ferrous alloys having the requisite properties.

Cast iron in particular has received great attention in view of the fact that it is used for many of the most important parts of a Diesel engine, namely, the cylinder heads and liners, pistons, piston rings, valves and other parts which are subjected to hard wear and high stresses at elevated temperatures. For such castings, ordinary grades of cast iron have not proved suitable, and various high-duty irons have gradually been developed having the required physical properties under working conditions.

High-Duty Castings.

It is not very many years ago since a tensile strength for cast iron of 9 to 10 tons per sq. in. was considered sufficiently high for all ordinary purposes, but to-day irons are regularly produced of about double this strength. The writer would like to mention one process in particular—the Lanz Perlit iron process—which in his own experience over the past six or seven years has given great satisfaction both for Diesel-engine castings and also for superheated steam-work. By means of this process castings are produced of high mechanical strength, both at ordinary and elevated temperatures, together with good wearing qualities, high resistance to shock and repeated impact, freedom from growth, and regularity of strength and hardness in various sections of the same casting. Incidentally, the castings are virtually free from casting strains and thus do not require annealing.

The knowledge of cast-iron metallurgy which has been gained in the development of high-duty irons has naturally resulted in the improvement of ordinary cast iron, and advantage can be taken of this in reducing the weights of such castings as bedplates and columns, which, owing to the conditions under which they work, do not call for the use of high-duty irons. From the foregoing it will be evident that foundries producing high-duty cast iron must, of necessity, be under scientific metallurgical control, as the old rule-of-thumb methods cannot cope with work of this character.



A 4-CYCLE SINGLE-ACTING DIESEL ENGINE, WORKING ON THE "BUCHI" SYSTEM OF EXHAUST TURBO-CHARGING. (SEE TABLE II, ENGINE NO. 2.)

In this matter of scientific control much real progress has been made, and a well-equipped laboratory is now a *sine qua non* in an up-to-date foundry producing high-duty castings. All materials must be analysed and every possible factor in the melting process brought under control in such a way as to ensure that metal of the correct composition and physical properties is produced with regularity and certainty.

Success with high-duty cast iron necessitates working very closely to "border-line" compositions, and differences, which are unimportant in ordinary cast iron, are of vital importance when dealing with high-duty work—hence the need for rigid control.

Coming to the second main line of development, from what has already been said it will be appreciated that the Diesel engine has introduced certain new features from the point of view of production. Those familiar with this type of engine will understand that many of the most important castings present considerable difficulties to the foundry by reason of their design. Thus, cylinder covers, pistons and certain other parts require to be water- or oil-cooled in service, and the provision of the cooling jackets in the castings gives rise to much complicated core work.

Castings of such a character would be difficult to make in ordinary grades of cast iron, but the difficulties are much increased when using high-duty irons. It is well known, of course, that the latter have not such good casting properties as ordinary iron, that is, they are not so fluid, higher pouring temperatures are necessary, and their shrinkage is generally greater. Moreover, there must be added the fact that the inspection of castings of this type is necessarily very rigid on account of their heavy duty when in service. In the writer's opinion, it is greatly to the credit of the skilled foundry craftsman that he has been able to adapt himself to this exacting work with such notable success.

In one direction the Diesel engine has had a notable effect on marine engineering foundry-work, which is due to the fact that this engine is generally built up of a number of identical units. This has led to an amount of repetition work not met with in steam work, and, consequently, to the introduction of machine moulding for certain of the smaller castings at all events. Further, it has been the writer's experience that, once having installed machines, it has been found possible to make use of them for numerous castings for steam work also, by means of a system of master pattern-plates, which makes it an economical proposition to use a machine if not less than five or six castings are required from a pattern.

TABLE II.—*Showing Recent Progress in Diesel Engines.*

	Type.	No. of cyls.	Bore and stroke.	Shaft-horse-power.	Overall length.	Height from crankshaft.
					ft. in.	ft. in.
No. 1, built early 1929 ..	Single-acting Diesel engine	6	730 mm. × 1,500 mm.	2,250	41 0	25 6
No. 2, built late 1929 ..	Single-acting Diesel with Buchi exhaust turbo-charging.	6	620 mm. × 1,300 mm.	2,250	35 0	23 0

Agricultural Engineering in 1931.

By G. E. ROWLAND (Chairman, Agricultural and General Engineers, Limited).

LOOKING back on the agricultural industry during 1931, one feature which stands out clearly is the greater interest in farming matters which has been shown by the general public. Those who formerly believed that the British farmer is inefficient and slow to adopt improved methods have as a result begun to realise that such accusations are unjust. Increasing use is being made of modern equipment, and although farmers all over the world are buying no more than is absolutely essential for their immediate needs, they see that old-fashioned methods are no longer profitable.

It is significant that the four Silver Medal awards made by the Royal Agricultural Society of England at their 1931 Show were all gained by power-farming equipment. Foremost among the successful machines was the Diesel tractor fitted with a high-speed, 4-cylinder "compression ignition" engine. This tractor was similar to the one which had previously established a new world's endurance record by ploughing continuously day and night for 977 hrs. The fact that the previous record, set up by an American petrol-engined tractor, was only 482 hrs., shows clearly that the superior reliability of the Diesel engine for farm work. In addition it shows a great saving in fuel- and lubricating-oil costs, which are from one-third to one-quarter of those of petrol- or paraffin-engined tractors. Progress has been carried still further by the introduction of a "roadless" Diesel tractor applicable both to agriculture and to transport over rough land where there are no roads or where only the merest tracks exist. The great value of the "roadless" tractor to the farmer is that it allows him to work on ground which the wheeled tractor could not negotiate without either sinking into, or "packing," the land.

Hitherto implements for tractor use have differed little in principle from those designed for animal draft. Recently, however, attention has been directed towards devising implements which apply the power of the tractor engine in a more direct manner. An example is the "Austral" rotary cultivator, consisting primarily of a number of rotating blades driven from the power take-off of the tractor. This implement performs in one operation the functions of plough, cultivator and harrow. Moreover the rotary movement of the blades helps the implement forward and relieves the tractor wheels of practically all tractive effort. Any tendency to "pack" the land is thus avoided.

MR. G. E. ROWLAND.

Another important new implement is a tractor drill controlled entirely by the tractor driver. The striking advantage offered by this machine is summed up by the experience of a farmer, who has stated that he would have required 10 horses and four men using horse drills to do the same amount of sowing as was done by this new implement with one tractor and one man.

Progress has also been maintained in improvements to existing machines. In the agricultural mower an enclosed automobile-type of gear-box with gears running in oil is being adopted. Amongst improvements in detail there is a more general use of ball and roller bearings. In the future electricity will play an increasingly important part in agriculture, and already several manufacturers of electric motors have introduced a complete range of portable and stationary motors designed to withstand the strenuous conditions of work both inside the farm buildings and out of doors. These few examples are sufficient to show that agricultural engineers and their farmer customers are pursuing a policy of progress. On the manufacturing side also up-to-date methods are being adopted. The agricultural-implement maker of to-day has a well-equipped works from foundry to assembling shop.

There is still great scope for the agricultural engineer and designer, for there are few crops of which it can be said that satisfactory machines exist for their cultivation at all stages. These gaps will be steadily filled, and with the long-expected return to agricultural prosperity in this country and abroad we can look forward to an increasing demand for British agricultural implements and machines.

Recent Developments in the Textile Engineering Industry.

(*Concluded from page* 23.)

perties the natural Belgian sand, thereby securing a marked improvement in the quality of castings, particularly the surface of large panels, small jobs with fine detail, etc. Also facing sands treated with oil have proved of particular benefit. Sea sand, now in general use for oil-sand cores and for which special stoves have been prepared, has added its share to a general improvement in castings.

During recent years every effort has been made to keep on the straight line of delivery for castings and raw material for the foundry. Where possible shutes have replaced barrows. Inflammable materials are isolated in wrought-iron bins, for safety, cleanliness and order. Men and machines are carefully grouped to eliminate excessive carrying of materials. Further, a general improvement in the textile machine trade would undoubtedly be the most beneficial development of recent years.

Difficulties in Modern Jobbing Foundry Practice.

By KENNETH S. JEWSON, A.M.I.Mech.E. (Engineer and Contracts Manager to Hobbies, Limited, Dereham).

MAN is born to trouble as the sparks fly upwards, and the brisk trade done in patent spark-arresters seems to indicate what a multitude of troubles may be found in any foundry; but if that is anything to go by, a jobbing foundry might well put up spare spark-arresters at each corner. There is no such thing as getting down to detail, intensive study of operations, or of fixing things once and for all. More work does not mean more of the same work, and less work means losing men with whom rests much accumulated experience.

It is uphill work and no respite, and the management is often too overburdened with the effort to maintain continuity of work to give anything like the attention to technicalities that can be given in a mass-production foundry of equal size; besides, the problems are of too short duration to warrant close study. Risks must necessarily be taken and too much left to the moulder for safety. Troubles are inevitable and yet disaster must not follow.

Rationalised Melting Practice Possible.

Efficient melting and the serving of the cupola with materials may, in any case, be arranged for, although in any one blow it may be necessary to put through widely differing mixtures to suit the floor. It not infrequently happens that the special requirements are so small that it is not possible to arrange for a suitable charge, in which case the only thing to do is to use ladle additions, which is a very hazardous proceeding. Much depends on pouring temperature as to whether or not a sound casting is produced, but often this can only be decided by experiment, and on a short run there need be but one or two losses, and actual out-of-pocket expenses are more than the worth of the job.

Variables.

The location of runners is also a matter that cannot always be right first time. Foundry work is not mechanical work, which a jobbing foundry knows to its cost only too well. Even sand needs to be of a different nature, and in a different condition, according to the work in hand, and almost of necessity a foundry tends to have special characteristics. But the resulting limitation cannot be allowed to debar any class of job in these hard times, even though troubles are bound to arise so that the foundryman is sure to be thought either unenterprising or incompetent.

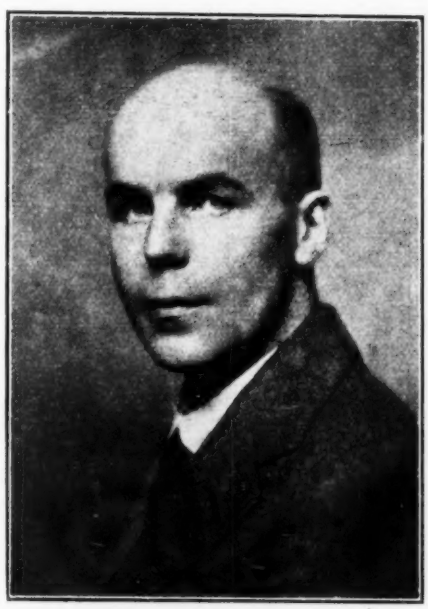
When he has worked up the output of a casting from small beginnings to fair quantities the mechanicalised foundry steps in and takes over at prices just out of his reach. One of the greatest difficulties is to secure proper remuneration, and it is the cumulative effect of the price at which each job is done that tells its tale at the end of the year. This absorbs an enormous amount of time and attention and is as important as watching costs.

Pattern Troubles.

A pattern arrives marked "One-off, *URGENT*"; if a small repair is necessary to correct a warp, or replace a fillet, it has to be attended to, and perhaps some sort of core box must be improvised. The customer is served, but as regards charge declares all he wanted was a casting, and that is how he had ordered before from other friends, and he dislikes being asked to pay for extras; besides, the last he had was seven years ago, and he expects prices to be down, not up.

Prices and Costing.

To open a new account is always a great encouragement, but results are sometimes far from happy. Having delivered the castings and charged them up, the foundry representative, full of hope and enthusiasm, walks all-unsuspectingly into the buyer's office to collect the repeat order duly merited. What he gets is intensive enlightenment regarding the unwisdom of taking advantage of an initial and open order to charge double what the price was before. "We buy these castings at 15s. per cwt." he is told. Later it is discovered that "these castings" referred to a set of castings ranging from a pound to a ton, and that the costing system possessed by the competitor consisted solely of a pair of scales. The buyer's view is that any foundry that is a foundry always turns out castings by the hundredweight, and surely anyone with any



MR. KENNETH S. JEWSON, A.M.I.MECH.E.

sense ought to see how invoicing is thereby simplified for all concerned.

It is difficult to change all bad practices, but the jobbing foundryman certainly ought to ascertain the expense of knowing what each job really costs, no matter how the charge is made; otherwise he is too much at the mercy of circumstance.

Of course, it pays to meet buyers by quoting per hundredweight if they wish it, and they themselves will often go out of their way to be accommodating. Overjoyed at having secured a promise of supplies at a reduction of 1s. per cwt., one buyer, with all the generosity in the world, volunteered to have the pattern repaired and improved before being sent along. Orders to "repair and improve" were duly issued, and the live patternmaker consulted the engineer, who by a stroke of genius saw how a core could be made about four times the size without altering the appearance or the strength of the casting at all, and, all unwittingly, bang went another nail into the unsuspecting foundryman's coffin.

Ultimate Use of Casting.

One of the greatest difficulties is not knowing the purpose for which a casting is required. There is no credit for care and attention lavished on the wrong points, and to overlook what to the user is an obvious requirement is a punishable offence, and it serves the foundry right if they have to replace the lot. The fact is, the foundryman is in as undignified a position as the last of a row of schoolboys passing on a dig in the ribs.

But what a joy it is when all goes well; a perfect pattern arrives that fits standard moulding boxes and is covered by a substantial order at a remunerative price; all concerned co-operate to put on record an achievement that will vastly enhance the firm's goodwill. Thanks to experience, foresight and intuition, there is not a waster, and the order is cleared in one grand delivery. The manager and foreman are left gazing speechlessly at each other with nothing to swear about, and the whole atmosphere becomes charged with the tension associated with the calm before the storm. This awful state is ultimately terminated by the laconic remark from the accounts department: "Who would have thought a firm of such standing could go so hopelessly broke!"

And yet we win!

American Business Forecast.

Dr. Lewis H. Haney, the well-known American economist, has set out in the "Iron Age" a list of favourable and unfavourable factors which will influence business in the near future. His favourable factors are:—

(1) Large gold reserves; strong Federal Reserve ratio; ample free gold; loan-deposit ratio normal.

(2) Speculative credit, measured by brokers' loans, is thoroughly deflated; stock market liquidation probably over 80 per cent. completed.

(3) Progress toward relief of railways through rate adjustments, voluntary credit pool, and wage reductions.

(4) Probability that many good bonds will be sought out by bargain hunters as soon as monetary fears are relieved.

(5) Possibility that the proposed Finance Corporation may have a favourable "psychological effect," while limited so as to prevent inflation.

(6) Wheat prices still hold a part of the autumn gain.

(7) World copper producers reported about to reach a workable agreement for "stabilising" the industry; copper market stronger.

(8) Machine tool orders gained more than seasonally in November.

His unfavourable factors are:—

(1) Commodity prices continue to decline.

(2) Factory employment and payrolls at new low levels.

(3) Sales of department stores, mail order and chain stores declined in November.

(4) Foreign trade below 1921 bottom, both exports and imports touching new low levels.

(5) Unfilled steel orders fell sharply in November, despite small shipments.

(6) Building activity fell sharply last month, reaching a level below the 1921 bottom.

(7) Automobile sales continue depressed.

(8) No relief yet apparent from accumulation of surplus stocks of various basic commodities.

(9) Large amount of frozen investments and security loans still burden the banks.

(10) Growing uncertainty as to value of money tends to paralyse business; proposals to inject Government credit into the Reserve System increase uncertainty.

(11) Large Government deficit and uncertainty as to adequacy of Administration's programme for balancing budget.

The Foundry Equipment Industry in 1931.

By D. HOWARD WOOD (President, Foundry Trades' Equipment and Supplies Association).

IT is not an easy matter for any one individual to report correctly on the equipment of foundries in this country during 1931. The Foundry Trades' Equipment and Supplies Association includes amongst its members makers of all types of foundry plant, equipment and supplies, but, unfortunately, no data are available from which the amount of equipment, etc., supplied can be accurately gauged. Members of the Association furnish a business-trend curve, but this is not yet available for the period under review.

Whilst many foundries have postponed development on account of general trade depression, it is pleasing to be able to report that by building new foundries and making extensions to existing foundries, quite a number of leading foundries have shown their faith in the future of the foundry industry in this country. Equipment makers have noted with pride during the trade depression that several of the most modern foundries have not only maintained full production through the year, but in some cases have increased their output. This increase in business has, however, doubtless been obtained at the expense of founders less well-equipped. There appears to be an increasing tendency for foundries, especially those making repetition castings, to develop a finished speciality in addition to supplying unfinished castings to manufacturers. Such foundries have apparently maintained their output in spite of the difficulties which have had to be met.

During 1931 a number of new foundries were built and equipped, and it is worthy of note that these foundries have mainly been on a large scale. Amongst such foundries reference may be made to a foundry in the North Midlands devoted to the manufacture of cast-iron pipes in sand-rammed centrifugal moulds. This plant was designed and installed to work continuously for a 24-hr. day. A new foundry in the Midlands has been equipped for the production on a large scale of light castings mainly for the electrical industry. In the North a foundry has been planned and built for the manufacture of medium and heavy castings for pumps, etc. Owing to lack of railway-siding facilities, special equipment had to be designed for dealing with incoming raw materials. This included a hoist capable of lifting a 5-ton lorry to storage-bin platform. In the South the first block of a large foundry for the manufacture of radiators, etc., has been built and put into operation; whilst considerable extensions have been made to a malleable-iron foundry at the same works. It may be of interest to note that in all the above cases the melting equipment installed consists of cupolas which are mechanically charged. An automobile foundry which will be the largest in Europe has been built, also in the South, and the process of equipping this foundry is nearly completed. In the Lancashire district two foundries for the production of very small castings on a large scale have been equipped and put into operation. It is calculated that the total tonnage of metal melted in the above foundries when in full production would be approximately 950 tons per 8-hr. day.

New Equipment.

The equipment makers have taken advantage of the partial slackness of trade to design and perfect new plant, and amongst the equipment which has been put on the market during 1931 the following may be mentioned: (1) A new type of vertical core-drying stove particularly suitable for drying cores of a repetition character; (2) the rotary type of furnace using pulverised fuel has been considerably developed, and foundry owners now have the choice of three furnaces. Although originally designed and put into operation on the Continent, some of these furnaces are now being built in the United Kingdom; (3) experiments had been made prior to 1931 with a new type of balanced-blast cupola, and a number of these have been installed and existing cupolas converted during the year; (4) a centrifugal casting machine particularly suitable for gear wheels, rings, etc., has been introduced, and is being used for the production of blanks in non-ferrous metals in one works; (5) an innovation in connection with moulding machines has been introduced in the form of an electro-magnetic machine for which special

MR. D. H. WOOD.

claims are made, and (6) the necessity for drying sea sand preparatory to use for core-making, etc., has apparently been realised more forcibly during 1931. Quite a number of machines for this purpose have been installed, and a new type of oil-fired sand dryer has been put on the market.

Considerable developments have been made in the design of sand-treating plant, and a large number of automatic installations have been installed.

Sand-Blast Plant.

Progress in this method of finishing castings has been made, mainly in the extended application for particular purposes. By improvement in the design of machines a greater variety of castings can now be treated by this process.

Mechanisation.

Whilst completely mechanical foundries are the general rule in the U.S.A. and have been adopted to a large extent on the Continent, probably owing to the limited demand for similar types of castings, such methods have not been adopted on any scale in this country. Several foundries have been completely mechanised during the period under review. In one case an automobile foundry in the Midlands has installed equipment reducing hand labour to an absolute minimum. A foundry in South Wales, by introducing completely mechanical handling, has greatly increased output and proved the value of this method for their particular product. It is interesting to note that in some cases where mechanisation has been introduced, those responsible for the lay-out of such foundries have selected plant of different makes rather than leave the details of the installation to any one firm of manufacturers, whilst in other cases the responsibility for the whole lay-out and supply of equipment has been placed upon a single firm of equipment makers.

Foundry Supplies.

The makers of foundry supplies have not been idle. Several of these firms have developed research departments for the express purpose of supplying products applicable for their special jobs. As one result, new products in the way of refractories, facings, etc., are now available, eliminating as far as possible any risk through variations in materials.

Prospects of Business.

It has been mentioned earlier that in spite of the difficult times new foundries have been built and extensions on a large scale made to existing foundries. Whilst at the moment these may not be working at full capacity, the equipment is built and everything is in readiness to deal with a considerable increase in output when the demand arises. By taking advantage of the temporary slackness to increase their output facilities, these foundry owners have, as stated before, given definite proof of their faith in the future of the foundry industry in this country. That there will be an increasing demand for castings, and not in the far distant future, is certain. This apparently is the conviction of a number of foundry proprietors if the inquiries for plant to replace obsolete equipment can be taken as an indication of their ideas. Undoubtedly, there are more inquiries for foundry plant being made to-day than has been the case for the past few years. The present low level of prices prevailing seems to indicate that the present is undoubtedly the most opportune time for the purchasing of equipment. Such equipment can be installed during a period of slackness with less inconvenience and consequently less interference with output. If the demand for "consumable stores" can be taken as a fair indication of the state of trade, then it can be said with truth that during the last two months there was a small but definite improvement in the industry.

The members of the Foundry Trades' Equipment and Supplies Association are fully alive to the requirements of the foundry industry, and they are ready to co-operate with founders to assist them to produce castings on the most economical basis. The plant, etc., they are able to offer is at least equal to that of their foreign competitors, and in some cases in advance of anything obtainable outside this country.

If "Battle goes to the strong"—then business goes to the best equipped.

In conclusion it can be stated that, in spite of the difficult times, the foundry industry is adapting itself to the changing conditions; new works are being erected and enterprising firms are placing themselves in a position to take advantage of the renewal of trade, which it is hoped may be hastened.

The Belgian Foundry Industry in 1931.

By GUSTAVE MASSON (Past-President, Belgian Foundrymen's Association).

THE year 1931, which opened with but mediocre trading conditions, closed in a lamentable atmosphere, exhibiting few signs of reassurance. No industry has escaped the acute crisis which has overtaken Belgium, in common with all its neighbours. Every industry—the heavy iron and steel, mining, coking, glassworks, cement and others—have all suffered. It has brought in its train serious reduction in output, accompanied by unemployment and its resultant misery, and these reductions have unfortunately been on the increase during the whole of the past year. Possibly what we would wish for most is a slight improvement, as well as for a measure of confidence, since this crisis can be called a crisis of lack of confidence, for it will not suffice for production to be reduced: rather is it essential that the traditional demand should be ahead of supply.

During the last months of the year Belgian industry was badly hit by the financial crisis, which was particularly severe upon several of its neighbours, and also by the customs barriers which have been erected against it. Belgian industry lives on by exports, and these protectionist movements can only aggravate the crisis and increase unemployment. Belgians are hoping for a reaction in the near future against this policy, for international exchange appears to the writer as essential for maintaining world equilibrium.

MR. GUSTAVE MASSON.

In every industry prices have crumbled, except that certain raw materials seem to be stabilised, and a few see therein an indication of an improvement in the near future or at least an amelioration of the crisis.

As if to confirm this, a reassuring note is struck by the fact that the producers of raw materials are striving for—despite the grave difficulties that they have to overcome—agreements which will have a salutary effect on the current situation.

Naturally the foundry industry has been hit by the repercussion of the world crisis, and, in these trades more than in most, unemployment is intense and selling prices are below costs of production.

The largest customers of the foundry industry—the heavy iron and steel works, the engineers, the public works departments—have stopped ordering, and the few orders which do enter the market are subjected to intense competition.

However, in spite of the gravity of the crisis, in spite of the numerous international complications of the moment, there exists amongst quite a few of the Belgian industrialists an undertone of optimism. The length of the duration of the current depression is an argument in favour of a rapid amelioration, and there is every reason to hope that the year 1932 will be better, if not much better, than its predecessors.

The Malleable Castings Industry in 1931.

By A. W. G. BAGSHAWE (Managing Director, Bagshawe & Company, Limited, Dunstable).

IN reviewing the past year from the point of view of the malleable-iron industry, it is impossible to ignore the effects of the world depression which we have experienced. The absence of orders and the suspension of contracts were followed by a rapid fall in selling prices. This was common to all foundries, but was particularly severe in the malleable-iron section, owing to the fact that prices are to a great extent "set" or controlled by the smaller foundries. To avoid closing down through lack of orders, many of these smaller firms made drastic reductions in selling prices, which soon spread throughout the whole malleable trade. There was, unfortunately, no correspondingly great reduction in the cost of raw material or production.

It can be assumed that there will not be any reaction or rise in the price of malleable castings under present conditions of trade. It follows that all those founders who have not already done so will have to equip and reorganise themselves in such a way that they can make a profit in spite of these lower prices. If they cannot do so, they must inevitably go out of business.

When considering equipment there is a tendency to think first of "mechanisation," that somewhat indefinite process by which many foundry managers hope to reduce their costs of production. In the moulding shop this process can be divided, roughly, into two headings—one, the handling of moulds; two, the handling and preparation of sand.

Materials Handling.

Unfortunately malleable work does not lend itself readily to any mechanical method of handling moulds. The low average weight of castings in a box necessitates an unreasonable quantity of conveying or similar machinery unless a more or less continuous supply of molten iron is available, and malleable iron cannot be melted either conveniently or economically at a slow rate. This applies particularly in the "blackheart" process where quantities of three, five or more tons are melted at once and the furnaces are tapped once every three or four hours.

Although there does not seem to be at present much to be gained by using mould handling machinery, there is no doubt that efficient installations for the preparation and distribution of sand will help to reduce costs considerably. The ratio of sand used per ton of castings produced is high on account of the average light weight of castings per box. There appears to be no reason why nearly all the sand used in malleable foundries cannot be mechanically handled and the use of shovels almost eliminated. Such plants should pay for themselves and increase profits in a very short time.

Rotary Furnaces.

The year 1931 cannot be passed by without particular reference to the increased popularity of the rotary and semi-rotary furnaces for melting malleable iron. It is noteworthy that all these furnaces depend on the use of pulverised coal. There are now five or six of these furnaces in work or in the course of construction and there is every indication that these new furnaces, both in this country and on the Continent, are producing a metal of first-class quality in an economical manner. An increase in the number of rotary furnaces may be expected if the manufacturers will do their share in perfecting and reducing the cost of lining material and at the same time improving the reliability and efficiency of the pulverising machinery.

Moulding Machinery.

Moulding machines have for many years been used extensively in malleable foundries. In proportion to output, the probability is that the malleable trade uses more moulding machinery than any other section of the foundry industry. Managers must not, however, overlook the fact that the best and most profitable returns from the purchase of moulding machines and equipment are only obtained when combined with an efficient system of sand preparation and distribution.

Very little improvement has taken place in the annealing process in the last twelve months. Without question many enterprising managers of malleable foundries are giving serious thought to the use of pulverised coal for annealing purposes. The experience of those foundries already using pulverised coal has proved that for annealing purposes it is quite as reliable as gas or oil and that it is more economical. Unfortunately the installation cost is at present high. Considerable economies could be effected in this respect if the makers of pulverising equipment could place on the market a really reliable small unit machine.

Nothing of serious commercial importance has been done to reduce the time of annealing, which is still one of the most serious troubles in malleable-iron production. It is understood that certain experiments have been made by

(Concluded on page 39.)

The Work of the Institute of British Foundrymen in 1931.

By ANDREW HARLEY (President, 1931-1932).

THE year just ended has shown definite progress in all the activities of the Institute of British Foundrymen. In common with many similar organisations, members have felt the effects of trade depression, and a considerable number have resigned their membership or have been erased from the roll. It is encouraging to report, however, that there has been a net increase in the membership of about 100, bringing the total membership of the Institute to 1936. It is even more encouraging to observe that a large proportion of these new members joined up during the last two months of the year; that is, during the period in which the effects of financial stringency became most apparent in other directions.

The past year has also marked definite progress in the endeavours of the Institute to serve the industry as a whole by undertaking work of national scope and value, in addition to the work so successfully undertaken in its meetings and other local activities. In spite of the increased expenditure involved and the general financial situation, the financial position is sound. We are not only able to balance our budget, but also to add something to our reserves.

The general activities of the Institute centre to a large extent around the work of the Branches. There are ten Branches, of which three have Sections or Sub-Branches meeting regularly in other parts of their respective areas. It is interesting to note that regular series of meetings have been held throughout the year in no less than 20 cities and towns. As a result a large proportion of our members is able regularly to attend the meetings and other functions, and the Institute is probably in direct personal contact with a much larger proportion of its members than most other similar organisations.

Foundrymen living in remote parts of the country, and in many countries overseas, are also becoming members in increasing numbers. Such members evidently find that the perusal of the Institute's literature and association with our organisation is of value to them in their work.

During 1931 no less than 114 Branch meetings have been held. Some of these took the form of informal discussions on problems of immediate practical value. The majority, however, were devoted to the reading and discussion of Papers dealing with some aspect of the ever-widening field of foundry practice. Papers dealing with recent advances in metallurgy, modern methods of foundry operations, foundry management and foundry equipment were presented. In many of these Papers new discoveries and pioneer methods of production were described and published for the first time. The requirements of the general founder were not overlooked, as several Papers dealing with methods of production in this section of the industry were included in the syllabuses of various Branches.

Probably the majority of our members are interested in grey-iron founding, and a large proportion of the Papers which are presented, both before the Branches and at the Annual Conference, deal with this branch of the industry. There are many members, however, who are engaged in steel founding, in malleable cast iron and in non-ferrous work. The Council always has the interest of these members in view, and a number of valuable Papers embodying much original work in these Branches of the trade have been presented during the year.

A popular feature of Branch activities has been visits to works, and during the year opportunities have been afforded in almost every part of the country for members to inspect foundries and other works of interest to foundrymen. The Institute is appreciative of the public-spirited action of the firms who have permitted such visits, and it also tenders its thanks to the large number of authors who have read Papers to the members and have freely given the results of their experience.

Three New Sections Formed.

That the opportunity of personal contact with other members and of regularly attending Branch meetings is appreciated, is proved by requests which have been received from three additional centres for regular series of meetings to be held. In response to these requests, a Section of the East Midlands Branch was formed at Lincoln during the summer, and is now in the midst of its first session's work. Early in November, a Section of the Lancashire Branch was organised at Preston to cater for the large number of founders in Northern Lancashire who wish to meet together regularly to discuss their problems. Nearly 70 additional members have joined the Institute as a result of the formation of this Section. At the end of November, the Scottish Branch held a meeting in Edinburgh, as a result of which arrangements have been made to hold meetings there in the interest of present and potential members resident in that area. It will be recalled that the Scottish Branch celebrated the 21st anniversary of its establishment last April, and the importance with which the work of the Institute is regarded is shown by the reception which was given in the City Chambers by the Lord Provost and the Corporation of the City of Glasgow.

For some years it has been apparent that there were opportunities of assisting the foundry industry, in addition to the opportunities offered by the Branch activities, by the Annual Conferences and by the publication of the Institute's "Proceedings," and towards the end of 1930 a Technical Committee was formed. During 1931 this Committee has made considerable progress with its work. It commenced by forming itself into five Sub-Committees dealing respectively with cast iron; cast steel; malleable cast iron; non-ferrous foundry practice, and sands and refractories; and each Sub-Committee has co-opted experts in its own field.

The functions of the Technical Committee, working through its Sub-Committees, are to review the present position of foundry technique; to interpret to the founder the results of modern research and discoveries; to advise him with regard to the practical application of those results, and also to suggest to the appropriate organisations subjects in which new researches or investigations may be usefully undertaken.

The members of the Committee and of the Sub-Committees are men engaged in various branches of the industry, some in a technical capacity, others as practical foundrymen, and the unique experience represented by such a body is being

THE INSTITUTE OF BRITISH FOUNDRYMEN.

OFFICERS, 1931–32.

PRESIDENT:
Andrew Harley.

VICE-PRESIDENTS:
V. Stobie, M.I.E.E.; C. E. Williams.

PAST-PRESIDENTS

R. Buchanan. (Deceased.) 1904–1905.
H. Pilkington. (Deceased.) 1906–1907.
F. J. Cook, M.I.Mech.E. 1908–1909.
P. Longmuir, M.B.E., D.Met. 1910–1911.
C. Jones. (Deceased.) 1912.
S. A. Gimson. 1913–1914.
W. Mayer. (Deceased.) 1915.
J. Ellis. (Deceased.) 1916–1917.
T. H. Firth. (Deceased.) 1918.
John Little, M.I.Mech.E. 1919.
Matthew Riddle. 1920.
Oliver Stubbs, M.I.Mech.E. (Deceased.) 1921.
H. L. Reason, M.I.Mech.E. 1922.
Oliver Stubbs, M.I.Mech.E. (Deceased.) 1923.
R. O. Patterson. 1924.
J. Cameron, J.P. 1925.
V. C. Faulkner, M.Inst.M. 1926.
J. T. Goodwin, M.B.E., M.I.Mech.E. 1927.
S. H. Russell. 1928.
Wesley Lambert, C.B.E., A.K.C. 1929.
F. P. Wilson, J.P., 1930.

HON. TREASURER:
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MR. ANDREW HARLEY.

THE INSTITUTE OF BRITISH FOUNDRYMEN.

Members.

Honorary life	16
Subscribing firms	43
Members	731
Associate members	980
Associates	163
Total	1,936
Branches	10
Sections of Branches	5
Junior sections	3
Committees and sub-committees of General Council	11
Branch meetings during 1931	114

Papers presented.

Cast iron	26
Steel	4
Non-ferrous	8
Malleable	4
Moulding methods (steel, iron and non-ferrous)	16
General coremaking, patternmaking, organisation, etc.	35
Total	93
Works visits	36
Nationalities represented in membership	11
Countries in which members are resident	17
Invested funds	£1,500
Bank balances	650
Total	£2,150

collected and arranged, and will be freely placed at the service of the members as a whole. It cannot be too strongly emphasised that this new departure will not overlap with the activities of the Research Association; in fact, the British Cast Iron Research Association, with whom the Institute has been closely associated since the formation of that body, has permitted several members of its technical staff to serve on the Technical Committee and Sub-Committees, and it has rendered valuable assistance for which the Institute is fully appreciative to both the Association and to the individual members of its staff concerned. The Technical Committee is complementary to the work which is being done in scientific research, and it is confidently expected that the Committee will prove helpful to research associations and other bodies who are undertaking similar work.

The Committee is at present engaged in an exhaustive review of the various specifications that are issued by purchasing bodies for castings of various kinds; some of the Sub-Committees are investigating standard and other methods of testing both raw materials and castings, and already a good deal of practical information has been collected.

At a very early stage in the Committee's work it was found necessary to adopt a system of recording publications and articles dealing with foundry practice, and as a development of this work the Institute has now commenced to publish monthly a Bulletin giving brief particulars of interest to foundrymen; this Bulletin is forwarded monthly to every member of the Institute.

Educational Activities.

The year 1931 has also marked the actual inauguration of the scheme sponsored by the Institute for the issue of certificates in foundry practice and in patternmaking. The examinations, and the issue of the certificates, is under the control of a Committee of the City and Guilds of London Institute which is composed of members of the Institute of British Foundrymen and of a number of technical and educational organisations. The syllabuses drafted by this Committee have been circulated to most of the leading technical colleges throughout the country, and the educational authorities are showing themselves very anxious to extend their existing facilities for instruction in foundry practice and patternmaking, and to inaugurate such facilities where they do not exist.

At the commencement of the present winter session in October, courses in preparation for the certificates were offered at about 30 technical colleges. Some of these courses are working very successfully and are being attended by a large number of students. On the other hand, in a few cases, the education authorities had reluctantly to cancel their courses owing to the small number of students who presented themselves. The apathy of the young foundryman himself is a problem which has already presented itself to those who are interested in his technical training; it is, however, encouraging to realise that the majority of these courses are in successful operation, and there are probably larger numbers of young foundrymen attending classes during the present session than has ever been the case before. It is too much to hope for an enthusiastic attendance at every centre during the first year, as this would imply an immediate and complete reversal of the tradition of apathy on the part of the young foundryman which is so well known. The great success which has already been achieved is encouraging for the future, and it is confidently hoped that in a few years' time the pursuit of technical training by the young foundry worker will be as general as it has been for some years on the part of his confrère in the engineering departments. The Junior Sections of the Institute, of which there are three, are undoubtedly contributing to foster the desired enthusiasm for technical knowledge on the part of the young members of the trade.

The National Certificates in Mechanical Engineering issued by the Institution of Mechanical Engineers and the Board of Education, may now be endorsed by the President of this Institute where the candidate has included certain foundry and metallurgical subjects in his course; some half dozen of these Certificates have been so endorsed.

The Annual Conference was held in June in Birmingham, and with the exception of the International Conference held in 1929, the attendance constituted a record. In addition to Papers on a diversity of foundry topics, an unusually large number of firms in Birmingham and Coventry invited the members to inspect their works, and the opportunity of witnessing foundry operations concerned with the large variety of engineering products produced in the Midlands, was eagerly accepted. The Conference also demonstrated again the indebtedness which the Institute owes to the firms who permitted these visits, and to the authors of the Papers which were presented. At this Conference the Oliver Stubbs Medal, which is the Institute's highest award, was formally presented by the Lord Mayor of Birmingham to Mr. John Cameron, Past-President,—"*who by his example has done much for the wider dissemination of foundry technique, particularly in the development of new methods dealing with foundry problems, and by his general activities has contributed to the advancement of the technical side of the industry*"—an award which won universal approval from the members.

One cannot be President of the Institute for very long without realising that an enormous amount of voluntary work is done by its members for the benefit of their fellows. The old conservative policy of secrecy in regard to methods of production has almost disappeared, and has been replaced by a desire to pool ideas, a policy which has been largely responsible for the remarkable progress which has been made in foundry practice in recent years. Additionally, a very large amount of administrative work is contributed voluntarily by the members. In an organisation in which the provincial Branch is such an important unit, it is obvious that much administrative work must be performed by the Branch officers, and this is done willingly and enthusiastically.

It is very pleasing to acknowledge the valuable co-operation and assistance which has been received throughout the year, and, in fact, for a period of many years, from THE FOUNDRY TRADE JOURNAL. The Institute has a close working arrangement with this paper in the reporting of its meetings and in the publication of its "Proceedings," and its relations with the JOURNAL have always been of the most cordial and friendly character.

In the spring the proprietors of the JOURNAL placed a portion of their advertising space at the disposal of the Institute so that members who are unemployed, or who desire a change of employment, could make their wants known through its columns free of charge; this feature has continued throughout the year and has been the means of helping several members into suitable employment.

Quite recently, the assistance of the JOURNAL was called in for the preparation and publication of the Index of Periodicals to which reference has been made, and Mr. Vincent C. Faulkner, the Editor, very kindly undertakes the whole of the by-no-means insignificant amount of preparation and editorial work involved.

The loss of membership which occurs each year can be explained by the uncertain and unsatisfactory conditions of trade which have affected many members, not only of this, but of other similar organisations; nevertheless, the number of new members each year has been in excess of the removals, and the Institute's total membership has shown a steady annual increase for several years past. The Institute is anxious to

(*Concluded on page* 42.)

The Malleable Castings Industry in 1931.

(*Concluded from page* 37.)

electrical engineers in America with a view to shortening the period of annealing. There does not, however, seem to be an indication that the process has yet been developed on sufficiently economical lines for everyday use.

Development in these various sections of the industry must necessarily vary with the facilities and financial resources of the individual foundries. It does, however, seem obvious that only those will survive who do bring their equipment up to date and who can make a fair profit at prices as low or even lower than they are at the present time. Apart from internal competition, malleable iron now has to compete with high-duty cast iron, steel castings, stampings, forgings, and, last but not least, welded or so-called "fabricated" steel parts. The high quality of these various products and the prices at which they are being placed on the market not only reflect great credit on the different manufacturers but are a definite sign to the malleable iron foundry to put its house in order.

If the malleable iron industry is to retain its position a determined effort must be made to stop quoting and accepting orders for odd jobbing lots of castings at ridiculous prices. On account of severe competition this practice has been most prevalent in the last year. In many of the foundries at least a quarter of the output is made up of small orders taken at prices that do not even cover the cost of labour. The future of the malleable trade depends to a great extent on quantity production in competition with forgings, stampings, and other similar products to which reference has already been made. If we are to hold our own we must concentrate on quantity production at a low price.

A few years ago statistics were published showing that the output of malleable iron castings *per head of population* in the United States was about six times as great as it is in this country. The market for malleable iron definitely exists. It remains with those responsible to develop that market. The first essential is the production of castings of first-class quality, but that is not enough. The cost of the castings must be such that they can be sold at a reasonable profit in competition with the products of those other branches of the engineering trade which now supply parts that could be produced with advantage by the malleable iron foundries.

British Industries Fair.

The Birmingham Section, which is to be held at Castle Bromwich from February 22 to March 4, has constituted itself as the greatest exhibition of foundry products in Great Britain. We have received an advance copy of the list of exhibitors, and we find that the majority are either foundry owners or incorporate castings in their products. Owing to the international financial situation, it can reasonably be expected that the influx of foreign buyers will be greater than in previous years. The floor space at Castle Bromwich is no less than 243,000 square feet. We were a little disappointed not to receive an overseas catalogue from Birmingham, got out on similar lines to that issued for Olympia and the White City. This is a very creditable production, containing alphabetical lists of exhibits in eight languages. There are only few firms in the foundry equipment business which are down as exhibitors, though furnace manufacturers are well represented.

XUM

Recent Developments in the Non-Ferrous Foundry Industry.

By H. C. DEWS (President, London Section, Institute of British Foundrymen).

NON-FERROUS founders have not lagged behind their colleagues in other foundries in contributing to the past year's developments. As well as one or two items which have been developed in common in all classes of foundries, it is proposed to mention below those features of new interest which are now found in certain non-ferrous foundries.

This review will be confined in general to the industries dealing with the alloys composed mainly of copper. Progress in the founding of aluminium, magnesium, the white-metal alloys and those alloys composed of two-thirds steel and one-third non-ferrous metals may be dealt with elsewhere in this number and will not be discussed here.

Work of Technical Societies.

The technical societies in which non-ferrous founders are particularly interested have all been active during the year. The Institute of Metals, the Institute of British Foundrymen and the British Non-Ferrous Metals Research Association have during the year commenced novel developments of great promise.

The Institute of Metals still retains its pre-eminent position as a medium for the original publication of research dealing with non-ferrous metallurgy. The March, May and September meetings were well attended and productive of many valuable Papers. The September meeting was held in Switzerland, and there, after a batch of Papers had been presented and discussed, the members contrived to blend business with pleasure by visiting important metallurgical concerns adjacent to notable resorts in Europe's playground country.

The Institute started a new service last year by publishing a monthly issue of its Journal. The Abstracts Section of the Institute's Journal had been increasing in size for many years and had become recognised a complete and valuable index to all technical information on non-ferrous metals published throughout the world. Until this year these abstracts were only published half-yearly as part of the Journal. From last January, however, the abstracts have been published monthly, and it is intended to repeat yearly in a separate volume the whole of the year's abstracts. The monthly pamphlet has also been used for making announcements of the activities of the Institute, personal notes about members and similar items of interest. Undoubtedly the monthly Journal has proved a popular innovation.

The Institute of British Foundrymen has also provided a new feature by its formation of a Technical Committee. This committee intends to collect data, compare experiences and pass authoritative opinions concerning foundrywork. The main committee has formed a number of sub-committees to deal with specialised branches of the trade, and one of these has been allotted to non-ferrous foundrywork, in which special sphere it is expected that its influence will soon prove of moment. The Technical Committee is also conducting an abstracting service which puts into the hands of members of the Institute an index to current non-ferrous and other foundry publications.

British Non-Ferrous Metals Research Association.

An outstanding item of importance has been the establishment by the Non-Ferrous Metals Research Association of central headquarters in London. During the ten years of its existence the Association's steady progress to consolidate its membership and enlarge its staff has been directed from a small headquarters in Birmingham, but most of its research has been carried out in University and other laboratories scattered about the country. Such a system was inconvenient, placed severe limitations on the resources available for the staff and was not productive of proper efficiency. The Association found itself in a position last year to centralise its activities. Commodious premises were taken near Euston Square and were expeditiously fitted out with a large amount of apparatus of which much is of an expensive and special nature. In the basement there has been fitted a small experimental foundry with three types of crucible furnaces. One is gas fired, of 100 lbs. capacity, the second is a newly-designed electric furnace in which the 120 lbs. crucible is heated by non-metallic resister rods, while the third

MR. H. C. DEWS.

furnace is of the latest high-frequency electric induction type which can be run to melt either ½, 11 or 22 lbs. of metal. These laboratories were officially opened during the summer by Lord Rutherford and work therein is now well under weigh.

In "Ten Years' Work for the Metal Industries"—a publication which has just been issued by the B.N.F.M.R.A.—there is a complete summary of the work which the Association has already accomplished. Many of the researches naturally deal with subjects not intimately connected with the foundry, but there are few which have only trivial interest to the thoughtful foundryman. One of the oldest of the Association's works—on the effect of impurities on copper—will surely come to be regarded by the non-ferrous metals industry as one of the most important pieces of research work of the age. The results published to date, which are only a small portion of the full programme envisaged, have already had important effects on the copper industry.

Another of the B.N.F.M.R.A. researches has had for its object the improvement in brass-ingot casting, and this work continues to make steady progress, and to provide knowledge valuable not only to brass-ingot founders, but also to foundrymen generally whose problems are at one point or another identical with those which have had to be studied. Die casting has also had attention from the Association, and in this work also several Papers have emerged which can be read with advantage by a wider audience than that to whose benefit this research was primarily directed.

In pure scientific work it is difficult to point to any one item discovered during the year which has any obviously immediate prospect of benefiting the ordinary foundryman. X-ray work continues along abstruse lines. Single crystals are not so much to the fore. The yearly crop of equilibrium diagrams has mostly been concerned with the least-used metals. Silver has appeared with cadmium, aluminium and copper in three such investigations. From the last of these some useful data on the problem of attaining uniformity—always a difficult matter with silver-copper alloys—have emerged.

Application of Research Results.

In turning from research to production, it may be noted that, in general, the non-ferrous metals have participated as much as any other branch of metallurgy in advancement originating in the application of research. It is being realised in industry that there is too great a lag between the publication of research results and their industrial application, and means are now being slowly developed for more readily translating science into practice. The organisers of research associations, amalgamations of concerns and rationalisation schemes are all trying to find a place in their programme for this important activity. In this respect, the central institutions are much ahead of individual firms, which, with a few notable exceptions, have made little deliberate provision for development of research. There have been signs recently of growing interest in this question, and such interest is particularly gratifying in the gloomy year which has just closed, when it would surely have caused no surprise if there had been, with declining profitable production, a reluctance to embark on experiments concerned with technical matters.

More attention is being paid to the technical aspect of alloy production in such matters as in the accurate control of composition, the elimination of impurities, the more careful adjustment of melting procedure and the evolution of novel casting methods.

Impurities in Copper.

In the control of impurities there is intense activity at the moment. The "Impurities in Copper Research" of the B.N.F.M.R.A. has already been mentioned, and the year under review has seen a further stage of this work completed. Six parts have already been published covering the effects of oxygen, iron, arsenic, bismuth and phosphorus separately, and of arsenic and oxygen together on otherwise pure copper. At the last March meeting of the Institute of Metals, Parts 7 and 8 of the copper research were published. These dealt with the effects on copper of antimony alone and of arsenic and antimony together, and some effects of these metals hitherto unsuspected were revealed.

The experimental work on which these two Papers are based is worthy of notice as breaking away in one important detail from previous similar work and as reflecting a sign of the times. For the first time for this research the alloys were melted in the high-frequency electric furnace instead of in a gas-fired furnace. Industrial production of copper has experienced a

parallel development. Until recently only tough pitch-fuel refined copper was available, but it is now possible to obtain properly deoxidised copper which has been melted in the high-frequency electric furnace. This may have far-reaching advantages for alloy making when the foundryman is in a position to take advantage of it.

Spectroscopic Analysis.

The increasing attention to small amounts of impurities in alloys has given an impetus to their study by means of the spectroscope. Although the spectroscope has been known and used for many years in many kinds of laboratories, it has not found much favour for the examination of metals. Last year at the Institue of Metals Autumn Meeting two Papers were presented which will be likely to create a wider interest in the spectroscope and provoke further communications from those who already have some experience of its use.

The new quartz spectroscope, suitable for metallurgical laboratory use, is not a cheap tool, but is comparable in price with a large modern microscopic outfit. But it may be used advantageously in the determination of small amounts of impurities to supplant long and tedious chemical analysis, and by reason of its ease of manipulation and the short time required to obtain positive results, it may soon save its cost in laboratories where the volume of work is sufficiently great.

The Papers by Brownsdon and Someren and Smith stress the point that care and wide experience are necessary in reading the results of an analysis by the spectroscope, but anybody who studies the splendid photographs illustrating these Papers will undoubtedly sense the nicety with which results could be obtained once the art of reading such spectrographs had been mastered. As an example, it is mentioned by Dr. Brownsdon that in brass it is possible to estimate cadmium, magnesium and calcium to the fourth place of decimals; lead, iron tin and nickel to 0.005 per cent., and so on. The speed of a spectrographic analysis is illustrated by Dr. Smith's remark that a full assay of the impurities in lead may be completed in half-an-hour. It cannot be long before the large non-ferrous foundry laboratories will find the spectroscope as necessary as they have already found the microscope.

The study of impurities for which the year's technical work has been chiefly notable has been extended in such a manner that before mentioning its development in practical fields it would be wise to define the meaning which has come to be placed on the word impurities in reference to alloys. Dr. Smithells mentions in his recent book, "Impurities in Metals," the difficulty which practical metallurgists have found in choosing a simple word which would cover the large number of metals and non-metals present in small quantities in all industrial alloys. "Impurities" implies possibly some harmful effect, but these small constituents are by no means all harmful or even accidental in their occurrence. However, there seems to be no other word which will readily meet this case, and "impurities" is thus now used for all minor constituents.

Growing Importance of Silicon.

The impurity which has received the most fruitful share of attention is silicon. Steel metallurgists have made use of the deoxidising effects of silicon in two different ways in the Bessemer and the open-hearth processes for many years. Silicon steels, too, in which a larger amount of silicon is added as an alloying element, have lately come to the fore. That in cast-iron silicon is the most important constituent everyone has known since the classical researches of Prof. Turner, which are now older, probably, than many readers of this Journal. In non-ferrous practice silicon has until recently played little part, but it appears at the moment to be likely to overtake its arrears.

The earliest use of silicon in the non-ferrous foundry was for the deoxidation of copper for electrical purposes, and later for the deoxidation of nickel and high nickel-containing alloys. Larger amounts of silicon were then experimented with, and a few years ago a range of useful alloys was discovered when 4 or 5 per cent. silicon was added to copper along with some manganese, tin and zinc. These alloys were first put on the market in the U.S.A., and about the same time a few similar alloys appeared in Germany. The development spread to this country, and one or two manufacturers quietly started using copper-silicon alloys. Finally, a year or two ago the alloys began to be widely advertised and to-day occupy a recognised place in non-ferrous foundry practice.

Two useful reviews of the copper-silicon alloys have been recently published. The more technical one was by Dr. Voce in the form of a Paper to the Institute of Metals, and the other was by Mr. J. Arnott as a neat, practical Paper presented to the Birmingham Conference of the Institute of British Foundrymen last June. These Papers show the silicon bronzes to be somewhat similar to the older tin-bronze and gun-metal alloys. Arnott gives as typical mechanical properties of an alloy composed of 94 per cent. copper, 4 per cent. silicon and 2 per cent. zinc, which he put into commercial production three or four years ago, the following values:—

Maximum stress = 16 *to* 22 *tons per sq. in.*
Elastic limit ... = 5 *tons per sq. in.*
Yield point ... = 7 *to* 10 *tons per sq. in.*
Elongation ... = 10 *to* 25 *per cent.*
Brinell ... ... = 100 *to* 120.

The casting properties of these alloys are somewhat different from those of the tin bronzes. The silicon bronzes have a greater fluidity, whilst at the same time they burn into the sand much less than ordinary bronze. Castings require less dressing, since they come from the mould with a smooth, clean surface. These properties make silicon bronze suitable for small intricate castings. Unfortunately a rather high shrinkage makes for trouble with porosity in steam and similar fittings.

Parallel with the displacement of tin from bronze by silicon there has been a development, chiefly in Germany, to replace some zinc in brass by silicon. Here again a set of alloys with useful mechanical properties has been developed. The following is an example: Copper, 81 per cent.; zinc, 14 per cent.; silicon, 5 per cent., when sand-cast, gives 34 tons per sq. in. maximum stress and 10 per cent. elongation.

This alloy can be cast fairly easily, has good fluidity, and with great care will make intricate castings free from porosity or oxide inclusions.

Yet another group of alloys upon which silicon has encroached is the aluminium bronzes. A general survey of these alloys was made at Woolwich by L. J. Brice. The published results show that silicon can be used to replace some of the aluminium in the old aluminium bronze without destroying the good properties for which this alloy is well known. One such alloy is: Aluminium, 7.25 per cent.; silicon, 2.86 per cent., and remainder copper. Its mechanical properties are:—

Maximum stress = 41.8 *tons per sq. in.*
Yield point ... = 20.0 *tons per sq. in.*
Elongation ... = 12.8 *per cent.*
Izod ... ... = 16 *ft. lbs.*
Brinell ... ... = 196.

It will be seen that the silicon alloys now provide suitable alternatives to the older alloys which in their respective fields have for so many years been unchallenged. With the bronzes, brasses and aluminium bronzes, a choice between the newer silicon alloys and the older conventional alloys will depend more upon metal prices and production costs—and particularly the differences in foundry practice—than on any outstanding physical properties.

Mention of aluminium bronze calls to mind the apparently wider attention this alloy is receiving at the moment. There have come on to the market several varieties of aluminium bronze, inevitably under high-sounding trade names, in the invention of which non-ferrous founders seem to be remarkably fertile, which contain besides about 9 per cent. aluminium, some nickel and other elements. In this composition the corrosion resistance appears to have been increased and certain of the casting difficulties of the simpler alloys to have been overcome.

Returning to silicon, attention must be given to another kind of alloy in which it plays a remarkable rôle. Such are the alloys which are heat-treated to bring them into a state showing their best properties and to secure what is now being called dispersion hardening. The alloy best known to be capable of dispersion hardening is Duralumin. In the quenched state this alloy is in its softest condition, but during a day or two after quenching it gradually hardens. A careful study of this process has shown that it can be reproduced in many other alloys by a similar quenching and tempering procedure. The essential requirement is that there shall be formed a hard constituent, usually an intermetallic compound, which is more soluble in the alloy at high than at low temperatures. On quenching, the hard material is retained in solution and the alloy remains soft, but on tempering the hard material precipitates in a very fine form and thus confers great hardness on the alloy.

It has been found that silicon is necessary for the age hardening of Duralumin, and that, furthermore, it may confer similar properties on other alloys in which it is present. Alloys containing nickel and silicon are particularly adaptable for dispersion hardening.

A range of copper-nickel alloys containing silicon which can be hardened by heat-treatment has been patented by Corson in America. In this country Griffiths, Jones and Pfeil discovered dispersion hardening to be responsible for a remarkable increase in the elastic limit of cupro-nickel. The following figures, taken from their Paper presented at the last meeting of the Institute of Metals, show the kind of results which are obtainable:—

TABLE I.—*Dispersion Hardening Due to Silicon in Cupro-Nickel.*

	Max. stress. Tons/ sq. in.	Elastic limit. Tons/ sq. in.	E. Per cent.	R.A. Per cent.
80/20 copper-nickel cold drawn ..	35.3	3.8	13½	57
With 0.17 per cent. Si, heat-treated ..	42.2	27.6	21	57

Still another kind of silicon alloy has been exploited by adding about 3 per cent. silicon to Monel metal. Heat-treated castings of this alloy, according to Arnott's Paper, mentioned above, have the following properties:—

Tensile strength = 40 *to* 50 *tons per sq. in.*
Yield point ... = *Over* 25 *tons per sq. in.*
Elongation ... = 15 *to* 25 *per cent.*
Brinell ... ... = 220 *to* 230.

The addition of silicon to Monel metal and similar alloys increases the fluidity and enables quite intricate castings to be made successfully.

Corrosion.

For many years extensive research has been carried out on the corrosion of brass condenser-tubes in marine service. A different view must to-day be taken of this work because of the wholesale adoption of copper-nickel tubes in place of the simple brass upon which the whole of the condenser-tube research has been concentrated. Cupro-nickel tubes with from 10 to 30 per cent. nickel have now been used on an

extensive scale and have been found superior to brass. The 30 per cent. nickel-copper tubes have proved an unqualified success and have been adopted as standard by several shipping companies. Although they have only been available for a short time it is said that already over three hundred ships, including some of the largest liners, are equipped with these tubes.

It appeared, in fact, some months ago, as if cupro-nickel was destined to supersede all other alloys for condenser-tubes both afloat and for land power-stations. But there is now another competitor in the field since the corrosion-resisting properties of aluminium-brass were discovered. Aluminium-brass, it has been found, quickly forms in water an oxide film which is sufficiently strong and impervious to corrosive influences to protect in service the underlying metal from further wastage. The oxide film is also self-healing, and should local abrasion expose the base metal a new film contiguous with the adjacent portions of the old quickly grows and arrests that pitting which has been such an insidious source of wastage of pure brass tubes. Several manufacturers have now placed upon the market under various trade-names tubes made from an alloy composed of 76 per cent. copper, 22 per cent. zinc and 2 per cent. aluminium.

Beryllium.

Though ordinary industrial foundry practice is not normally concerned with the rarer metals, yet mention must be made here of at least one rare metal which is capable of making remarkable incursions into practice. Beryllium has been known since 1798, but it has only been studied since its preparation in compact form recently became possible. During the last year or two its properties and the possibilities of its commercial application have created wide interest. In alloys, small amounts of beryllium appear to exert quite exceptional effects and to make available properties hitherto unattainable.

Little attention has been devoted to beryllium in Great Britain except at the National Physical Laboratories. In Germany particularly and in the U.S.A. there is proceeding quite a lively industrial inquiry, and it is rather regrettable that similar commercial development of the now available research data has not been attempted in this country.

Beryllium metal is slightly heavier than magnesium but lighter than aluminium, and its melting point is higher than either, being about 1,280 deg. C. It is a more powerful deoxidiser and desulphuriser than aluminium, phosphorus or magnesium. The properties of some beryllium alloys are shown in Table II, and these suggest many uses if only the price can be reduced sufficiently. Already these alloys are being tried for such purposes as springs for aeroplane undercarriages, internal-combustion valves, electric-

TABLE II.—*Properties of Beryllium Alloys.*

	Max. stress. Tons/sq. in.	Brinell.
2.5 per cent. Be. in copper, quenched and tempered	33 90	100 440
6 per cent. Be. in copper ..	—	730
2.5 per cent. Be. in nickel, quenched and tempered ..	80	600

motor brush-holders and collector-rings, special bearings, and so on. In all cases, however, so far, they have only been tried in machinery of the super-luxury of experimental class where price is of no consequence.

At the moment it is price which keeps beryllium out of most commercial practice, but this need not delay its development, because there is reason to believe that with increasing demand its price would be substantially reduced. It must be remembered that fifty years ago aluminium was a similar curiosity, yet extensive production has brought it down to commercial levels. While the amount of beryllium in the earth's crust is not so extensive nor so easily collected as aluminium, yet the present far-from-complete survey, which has mainly been carried out to discover beryllium in the gem form as emerald and aquamarine, has shown there to be widely-distributed lodes. Table III shows the

TABLE III.—*Prices of Aluminium and Beryllium.*

Aluminium.	Per lb. £ s. d.	Beryllium.	Per lb. £
1855	22 0 0	1922	4,500
1886	1 8 0	1923	650
1889	0 8 0	1925	220
1890	0 7 0	1927	90
1900	0 0 11	1929	33
1914	0 0 9	1930 (March) ..	20
1931	0 0 9	1931 (November)	17

similarity in the reductions in price of beryllium and aluminium.

Foundry Developments.

Parallel with the metallurgical developments in 1931 there has been a number of improvements and innovations in foundry practice, a few of which must now be mentioned particularly.

For metal melting improvements are being effected quickly and in many directions. The electric furnace is continuing to gain ground with the increasing rate with which it has advanced for the last ten years. For brass melting for ingot casting the Ajax-Wyatt type of furnace has now definitely become the standard unit. Improvements in the lining of this furnace, the limitations of which have hitherto restricted its use to brass, are being tried so that it may be used for copper and some other alloys. For higher melting point alloys, such as copper-nickel and nickel-chromium, the high-frequency electric furnace continues to advance into favour, and one continually hears of one or another firm installing this type.

In the iron foundry a great deal of attention has been given to the new rotary furnaces fired by pulverised coal. In the non-ferrous foundry also the rotary type of furnace is being developed, but it is usually here oil-fired. Pulverised fuel seems to have had very little application to non-ferrous foundry work.

Several of the more conventional types of furnaces have been improved, and in particular many have been adapted to burn oil fuel. There has been put on the market lately a small reverberatory furnace which incorporates oil firing and an ingenious air-preheating device. This furnace appears to have given a good account of itself during the year.

Casting processes continue to improve, particularly in the use of permanent moulds and in centrifugal casting. Not very long ago permanent moulds usually meant heavy cast-iron chills which were frequently not too-well designed or made, and were used without much understanding, so that they were all too often far from permanent. The improvements in iron-foundry metallurgy and technique have brought some relief to the non-ferrous founder and a much longer life may be expected to-day than previously from cast-iron chills. Other metals for making chill moulds have lately been used, and considering the success of some of these alternatives to cast iron, one wonders why this development has been so long delayed. In particular, copper has found favour for making ingot moulds wherever the prejudice against its comparatively high price has been overcome by faith, generally justified in experience, in its longer life and ultimate saving. Often copper moulds are water-cooled, which protects the ingot mould from any chance of deterioration and improves the quality of the ingot.

Centrifugal casting has lately achieved large dimensions both in cast-iron and non-ferrous foundries for making pipes, piston-liners and rings, gear-wheel blanks and other parts.

For gear-wheel blanks in phosphor bronze, centrifugal casting has become so much a recognised procedure that the new B.S.I. specification No. 421—1931, for *Phosphor-Bronze Castings for Gear Blanks*, includes special test-figures for this type of casting. A significant indication of the success of centrifugal casting is that the figures required are higher from centrifugal castings than from either chill or sand blanks. A sign of the popularity of centrifugal castings is the appearance on the market of a compact machine for making them. Hitherto the mechanical details of machinery for this purpose have been developed quietly by one or two firms specialising in this form of production, and foundrymen intending to embark on centrifugal casting have been faced with either making their own designs or entering into negotiations for drawings and advice with established gear-makers. It is possible now for the uninitiated to purchase satisfactory equipment on the open market.

Market Conditions.

With the three metals, copper, tin and zinc, restriction of supply is the basic feature of the producers' activities. On the other hand, the nickel producers have developed their market control in the opposite direction. The extensive publicity with which no foundryman can avoid being familiar, the research and development activities the results of which have been mentioned above, and the unstinting pandering to every interest of the consumer, have been notable features of the nickel industry. Coincident with this policy, nickel has maintained, in an industrial atmosphere clouded with depression, its stable price. Other base metals, copper, tin, and zinc and lead, have been this year little more than half the price they held a few years ago, but it is doubtful if the founder—or the user—has benefited to the slightest extent.

The Work of the Institute of British Foundrymen in 1931.

(*Concluded from page* 39.)

orient its policy so as to make itself additionally useful to its members, and so tend to prevent the number of removals from the register.

For many years the Institute's policy has been directed towards furnishing practical help for the benefit of its individual members. The year just closed has marked the active commencement of an additional policy directed towards providing its members with even more definite and precise help, and also directed towards the improvement of the technical practice of the foundry trade in general. It is believed that the work of its Technical Committee and its educational work will have far-reaching consequences within the next few years.

The progress made by the foundry trade in recent years is generally admitted; the Institute's part in contributing to this progress is also generally understood, but the past year has found the industry faced with many new problems due to the demands of the designer for castings which will fulfil more exacting duties, and also from more severe competition within the industry itself.

The Institute has rapidly adapted itself to these new demands upon its energies, and it is becoming evident that the founder who remains outside its ranks is handicapping himself severely in the problems that he has to face.

We have good reasons for looking forward with optimism. There are no signs of apathy in our organisation, but rather of increased energy and determination to win through. In this work we strive to serve and advance the general good of our craft. It means the exercise of goodwill and much disinterested service, and thereby we may learn something of the art of living as well as the art of making castings.

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Cast Iron from Ore to Mould.*

By P. A. RUSSELL, B.Sc.

THE object of these Papers has been to tackle one aspect of foundry practice and to try to reach some conclusions thereon. The problem selected has been the metal used—to find out how far its origin from the ore, its mixing and its melting determines its ultimate properties.

It is proposed to sift the evidence that has been put forward in the Papers and discussions, and to ascertain where there has been agreement or otherwise, connecting the whole by observations from personal experience, giving the source of any information used as far as possible.

Pig-Iron.

Probably the most interesting point that has been brought out about pig-iron is that the best results are obtained when it is used with due regard to both fracture and analysis. Mr. Hacking said that fracture was dependent upon silicon and the rate of cooling of the pig. This may be true of one particular furnace working on one type of burden, but no doubt most founders will agree that different furnaces can produce a different fracture from similar analyses and cooling rates. Mr. Hacking did not seem to attach much importance to the total-carbon content of the pig, but from a foundryman's point of view this is very important, both from the point of view of strength and soundness of castings.

It was generally agreed that furnaces working with cold blast (that is more slowly) produced a better foundry pig-iron than hot-blast furnaces, and that when the burden was enriched with mill scale, steel or iron scrap, the pig-iron was less satisfactory to the ironfounder. Mr. Hacking gave as a possible explanation the effect of the larger volume of atmospheric nitrogen which passed through the slower furnaces being absorbed in the iron and affecting its properties. He was not, however, in a position to prove this.

Considerable discussion took place with regard to pre-war *versus* post-war pig-irons, and although opinions varied as to whether post-war pig-irons were inferior or not, it seemed to be agreed that such inferiority, if any, was due to the higher working rate of the modern furnace, economic conditions having squeezed the old-fashioned slower type of furnace out of existence. The regularity of quality of pig-irons from a constant source was also discussed. Mr. Peace had stated that regular pig-irons could be obtained, but Mr. Young disagreed, and personal experience is that with the suppliers of common pig-irons this is not the case.

Steel Scrap.

Of other materials charged into the cupola steel scrap is probably the most important. This is introduced as a cheap way of reducing the mean carbon, silicon and phosphorus contents, and its use is now a recognised practice, though it is not so very long ago since it was considered essential to remove all bolts, etc., from scrap iron before it was used. According to personal experience, up to 10 per cent. of steel scrap can be used in any mixture without further consideration, but when more than this amount is used due regard must be paid to the cupola conditions if the metal is to cast without shrinkage troubles.

Scrap Iron.

Two sorts of scrap iron are available for cupola charges. Firstly, the domestic scrap from runners, risers, etc. (to say nothing of wasters). The composition of this is known and it can be used without fear. It is often an advantage to have a proportion of this "remelt" scrap in the charge as its composition is reasonably constant, whereas with an all-pig charge there is a risk of irregular melting and mixing of the liquid metal.

There is also scrap iron from outside sources, and the extent to which this can be used depends upon (1) the importance or otherwise of the composition of the final metal; and (2) whether the scrap is all of one type or not. For work requiring accurate mixture calculation it is difficult to use much of this type of scrap iron.

Ferro-Alloys.

Ferro-silicon, ferro-manganese, ferro-phosphorus, etc., can all be used with advantage on special work, but it is usually preferable to buy pig-iron that will give the right proportion of these elements without these additions, provided the amount of iron required is sufficient to justify the purchase of a special truck of pig-iron. It is felt that with ferro-alloys, the proportion used being so small compared with the rest of the charge, there is a grave risk of inadequate mixture, though ferro-alloys have been used with considerable personal success. All reference to the more expensive and unusual types of alloys such as nickel and chromium has been purposely left out of this discussion, as it was felt that this was outside the scope of the present purpose.

Mixtures.

Mr. Young has stated that "given a high- and a low-silicon hematite, a high- and low-silicon phosphoric iron, some ferro-manganese, some steel scrap, and some scrap iron, it is possible to produce cast iron of any quality," the essential condition being that there must be absolutely strict metallurgical control. This statement was not disputed in the discussion and seems to be correct. Where, however, *strict* metallurgical control is not possible owing to the size of the foundry, it is often desirable to use a proportion of high-class pig-iron when making work of an important character. It thus becomes a matter of economics—cost of strict metallurgical control *versus* cost of special irons. It will be noticed that *strict* metallurgical control is emphasised, and this involves not only the routine analysis of materials and products, but cupola control and the calculation of mixtures by a man who understands his job. Strict metallurgical control is not necessary for a large number of foundries producing castings not working under severe conditions.

One question suggests itself, and that is if it be desired to produce a low-silicon, low total-carbon cast iron, is it preferable to produce this from a refined pig-iron or from a mixture of common irons and steel scrap? There are wide divergencies of opinion on this point and it is doubtful whether unanimity can be reached at the present time.

The Cupola.

Mr. Hurst has emphasised in his Paper the importance of the air supply, particularly the volume of air used. Mr. Young has rather scouted the idea of the importance of blast-volume measurement and says that pressure is more important. There are two methods of producing the cupola blast—the positive blower and the fan type of blower. The two types require different treatment for control of the air supply. With a positive blower the volume of air delivered is proportional to the speed of the blower and, within limits, is irrespective of the resistance offered to the blast by the furnace. Thus the volume of air delivered into the cupola by a positive blower must be controlled either by altering the speed of the blower or by blowing a variable amount of air to waste. If the former method be used a pressure-gauge will give as good results for comparative purposes as a volume meter.

With a fan-type blower the volume of air passed into the cupola is dependent not only on the speed of the fan but the resistance offered by the cupola charges, and an increase in pressure usually means a decrease in volume, so that a pressure-gauge is of very little use in connection with a fan-blown cupola. With a volume-meter the speed of the fan need not be varied, but the volume can be controlled by means of a simple gate-valve. It is always advisable to have the cupola blower well over capacity, for the air supply can be readily diminished, but not so easily increased.

It is agreed that the best results are obtained from a cupola both from an economic and metallurgical point of view when the coke consumption is at its minimum to give the requisite tapping temperature. It cannot be too strongly emphasised that the blast volume should be proportional to the coke used, and it will be found that different sorts of coke require different blast pressures and volumes. The author would like to emphasise the soundness of Prof. Piwowarsky's method of tuning-in a cupola as outlined by Mr. Hurst.

Cupola Practice.

It is impossible to deal with all the aspects of cupola practice in this summary, but some of the points raised in the discussion need reference. Mr. Sanders, for instance, deplored the lack of standardisation in cupolas, but, while agreeing in the main, it should be pointed out that cupolas need to differ according to the type of iron to be melted. One of the advantages offered by the balanced-blast cupola is its adaptability to all types of mixtures.

Mr. Hallamore has asked what is the best height for a cupola. The minimum height above the tuyeres is usually given as 2½ times the diameter and the best results are obtained at about 4 to 5 times the diameter. Mr. Goodwin has stated that the melting zone of any one cupola is fixed, but it is suggested that a fluid iron will melt higher up in the furnace than a comparatively sluggish iron, and that the melting zone is a much more variable thing than most people imagine. This is borne out by Mr. Young's remarks on the tapping temperatures of various irons.

Mr. Hurst has not yet replied to personal written questions as to the alterations in cupola practice to suit various types of irons. It is, however, suggested that coke consumption should be kept at a minimum as stated above, with corresponding volume changes in the air supply. It should be remembered that with irons not readily oxidisable in the cupola, it is possible to use more air per lb. of coke, getting a greater CO_2 : CO ratio.

Changes in Cupola Melting.

Broadly speaking, charges will melt with the minimum of alteration in composition, if the iron is melted quickly, if the coke bed is low and if the blast is distributed as evenly as possible.

(*Concluded on page* 46.)

* Paper opening a joint discussion on the following Papers: (1) "Notes on Blast-Furnace Practice," by R. A. Hacking, M.Sc. (F.T.J., November 12, 1931); (2) "The Cupola Furnace," by J. E. Hurst (F.T.J., November 19, 1931); and (3) "A Note on the National Position of Metallurgical Knowledge and Efficiency in Ordinary Iron Foundries," by H. J. Young (F.T.J., December 11, 1931), held by the East Midland Section of the Institute of British Foundrymen, Mr. Spiers presiding.

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CONTRACTORS TO THE WAR OFFICE AND THE ADMIRALTY

(*Concluded from page* 44.)

The loss of silicon and manganese through oxidation and the gain in sulphur from the coke are generally understood. It is round the question of carbon pick-up that the main interest of the discussion ranged.

Firstly, steel scrap iron can be used for two distinct purposes, one to reduce silicon, phosphorus and carbon, and the other to reduce silicon and phosphorus, but to rely on the carbon pick-up in the cupola to bring the carbon back to normal. Mr. Saunders recommends that 2.8 per cent. should be reckoned as the carbon content of steel for calculating cupola mixtures, but lower figures than this can be used with suitable cupola conditions. If excessively high total-carbon pigs are used, there is a tendency for this to be reduced in the cupola.

A very great deal of interest is attached to high-duty cast irons having low total carbon. It is unfortunate that the proposed Paper on high-duty cast-irons did not materialise. No attempt is being made to fill that gap, beyond mentioning a few of the processes that rely on low carbon:—(1) Emmel, where cupola control and superheat are the important factors; (2) Meehanite, using almost 100 per cent. steel with ferro-alloy additions; (3) Corsalli, where the coke is treated to prevent carbon pick-up; and the many processes employed by various firms without use of elaborate names and patents.

The main point of interest is, how can the carbon be controlled in the cupola? The conditions already given for operating the cupola with a minimum of alteration in composition also apply here. But there is also considerable evidence that the type of coke used also has a bearing on carbon pick-up. Mr. Hurst has referred to the "reactivity" of coke in this connection. Mr. H. C. Dews, in a letter to THE FOUNDRY TRADE JOURNAL, has given evidence that the type of coke used is the most important factor. Founders should be able to determine this for themselves by a few practical experiments with different cokes, using a standard charge.

Before leaving this subject it seems germane to raise two questions:—(1) Is low total carbon desirable and (2) is it essential for high-duty cast iron? Most founders will agree that it is not desirable, from the foundry point of view. In the words of Mr. Young it is *difficile*, and a Paper by Mr. West,* published recently, amply bears out this. Two samples supplied to the speaker by Mr. Dews show the effect of low total carbon on shrinkage.

Personal opinion is that a high-carbon iron gives external soundness with internal porosity associated with coarse graphite, while a low total-carbon iron gives, or helps to give, internal soundness, with a great liability to external sinking. Mr. West has given a figure of 3.25 per cent. total carbon (irrespective of the silicon) as the minimum for freedom from external shrinkage trouble.

TABLE I.—*Composition and Eutectic Point.*

Si.	P.	C. eutectic point.	Si.	P.	C. eutectic point.
1.0	—	4.0	2.0	1.5	3.25
1.0	1.0	3.7	2.5	0.5	3.4
1.5	0.5	3.7	2.5	1.0	3.25
1.5	1.0	3.55	2.5	1.5	3.1
2.0	—	3.7	3.0	1.0	3.1
2.0	1.0	3.4	3.0	1.5	2.95

These figures are for slow cooling.

It would seem from purely theoretical considerations that one could more safely use high total carbon with low silicon and phosphorus than with high. The eutectic point of carbon in cast iron is altered by the presence of silicon and phosphorus, and Table I shows this very approximately; these figures are for slow cooling. Any excess of carbon over the eutectic amount will give coarse primary graphite, which is a great source of weakness and porosity.

The discussion on carbon pick-up from Mr. Hurst's Paper brought out many interesting points of view. Mr. Goodwin is at variance with other authorities with regard to the influence of type of coke. He also states that iron with 2.8 per cent. total carbon is regularly produced in the cupola. This statement is not much help without details of the other elements present. The speaker had produced iron with lower total carbon than that, though the silicon was far from normal. A percentage of 2.8 is by no means an unattainable figure in practice with ordinary compositions with suitable charges and cupola conditions. Mr. Armitage suggests that excessive carbon pick-up is associated with large charges and due to irregular height of bed, and it is agreed that this is quite reasonable.

There is a tendency nowadays for a reaction against the very low total-carbon irons, strength and soundness being obtained by closer control of cooling rates and pouring temperatures and the use of fine-grained raw materials, thus influencing graphite size and shape. Graphite size and shape is much more important than quantity, the form of graphite in blackheart malleable cast iron being an extreme example.

There is a vast amount of investigation going on at present into this question of graphite. Fine-grained pig-irons usually give fine-grained castings. Various theories are held as to the reason for this, the most common being that coarse graphite does not completely dissolve on melting, forming nuclei for large graphite in the casting. There is no general agreement on this question yet. Various attempts are being made to reduce the graphite size by agitation or superheating, but complications have arisen, and it seems as if this is still in the laboratory stage, and cannot be applied to ordinary foundry practice. So the old problem remains—how can we make a bad iron good?

* FOUNDRY TRADE JOURNAL, October 29, 1931.

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Rolls and Cupola Melting.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—Your leading article on December 31 quite rightly stresses the value and importance of researches by Mr. Caswell and Prof. Bacon, published by the South Wales Institute of Engineers, dealing with the breakage and failure of chilled rolls.

It may be worth while pointing out that Mr. Caswell deals largely with the practical side, by analysing returns from mills and previous history of rolls. Prof. Bacon has made an elaborate mathematical analysis of stresses involved in rolling and also on cracked rolls.

Even technical men are sometimes suspicious of mathematical analysis, but I would like to urge that this is a new method of studying technical problems, and that, in time, when physical constants have been more fully determined, definite practical results may be looked for. At present we are in the position of referring to specialists those matters we cannot be expected to understand, in order that their work may be correlated with the more practical aspects. In other words, while we may not understand the working, we may comprehend the results, and some day make use of them.

In the same number you print the very interesting discussion upon Mr. Young's Paper on cupola working, and I would like to say that I am in almost complete agreement with Mr. Young's view.

I have found it quite possible in making not only chilled rolls, but also other special iron castings, to employ almost entirely local materials. This is, of course, working solely by chemical analysis, but also exercising judgment, particularly in connection with pig-irons of high total carbon.

There are two points which are frequently overlooked in discussions such as the one in question.

(1) Each foundry has its own method of charging and working the cupola, so that material which is right under one system may be wrong under another, and

(2) Few, if any speakers indicate the proportions of scrap and pig, and also the nature of the scrap. Hence it is difficult to imagine that any one kind of pig is essential for any particular casting, since probably only 10 or 20 per cent. of it enters into the mixture.

The views expressed in Mr. Young's Paper seem to have given a shock to some foundrymen, but it appears to me that in dealing with variable material like pig-iron, a system which demands certain kinds is lacking in flexibility, and the obvious solution is to build up a system which will deal with variations, both of composition and price, and produce the desired uniformity of product at an economic figure.—Yours, etc.,

A. ALLISON.

19, Bowood Road,
Sheffield.
January 5, 1932.

More Customs of the Trade.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—Further to your editorial in the issue of the 10th ultimo, and the reply thereto from the Secretary of the Leicester Branch of the Ironfounding Employers' Federation, we are instructed by our Committee to say that in this district, also, it is not customary for ironfounders to insure customers' patterns against fire or other loss.—Yours, etc.,

WEBB & HALL,
Secretaries.

Manchester and District Ironfounders Employers' Association,
90, Deansgate,
Manchester.
January 6, 1932.

Book Review.

Mechanical World Year Book, 1932. Published by Emmott & Company, Limited, 65, King Street, Manchester. Price 1s. 6d. net.

Foundry executives will find that in this edition the section dealing with metals and alloys has been rewritten. A useful graph for converting Brinell to Shore and tensile strength has been included. We see no reason for the ultimate strengths of metals (p. 291) to be given in lbs. per sq. in., as the British invariably visualise such data in tons. A similar objection is made to the use of the Fahrenheit scale for the melting points of metals. The most serious criticism is the lack of concordance between the second table on p. 291 and that on p. 292. As there is a tendency for melting-point figures to increase, owing to modern methods making for greater purity, we would counsel readers to use the higher figure in general. Despite these small defects, the book is extremely useful.

MESSRS. RUSTON & HORNSBY, LIMITED, Lincoln, have secured an order from the Russian Government for about 100 vertical oil engines for the equipment of a fishing fleet.

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FTJ. 14.1.32.

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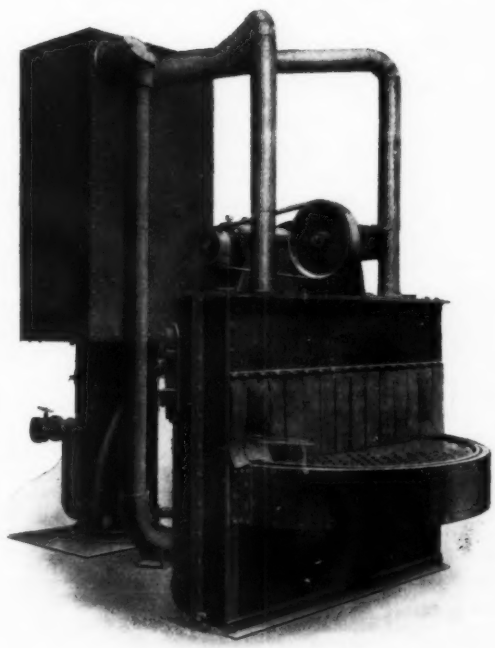

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This Week's News in Brief.

Trade Talk.

EMPLOYEES OF THE Lanarkshire Steel Company, Limited, Flemington, Motherwell, held their annual concert and dance on January 5.

THE GOODWILL and all patterns and drawings, the property of Messrs. Tinkers, Limited, boilermakers, of Hyde, have been purchased by Messrs. Daniel Adamson & Company, Limited, of Dukinfield.

MESSRS. BABCOCK & WILCOX, LIMITED, state that their contract drawing offices, which have hitherto been located in the London office, have been transferred to their Renfrew works. The designing department remains in London.

MESSRS. HENRY FORD & SON, LIMITED, have placed with the Constructional Engineering Company, Limited, of Birmingham, an order for the cupola melting plant to be used in connection with the new foundries at Dagenham.

A PETITION HAS BEEN SENT to the Board of Trade, signed by nearly 1,000 men formerly employed at the Brymbo Steelworks, near Wrexham, urging that some protective measures should be enforced which will enable the works to reopen.

MESSRS. BERNARD HOLLAND & COMPANY, 17, Victoria Street, London, S.W.1, have recently been appointed sole selling agents for the Darlington Rustless Steel & Iron Company, Limited, Darlington, for their stainless-steel product made under the Wild licence.

MESSRS. THOS. E. GRAY & COMPANY, LIMITED, 119, High Holborn, London, W.C.2, have acquired the sales rights of the Oehms portable mould-drying stoves and the Poumay cupola control system. Both these plants have met with considerable success on the British market.

THE GLASGOW CORPORATION TRANSPORT DEPARTMENT has decided to try a new Diesel engine made by William Beardmore & Company, Limited, on one of its omnibuses. In the event of the trials proving satisfactory, production will proceed on a large scale.

LARGE EXTENSIONS to the works of Qualcast, Limited, Derby, have been in hand for some time, and two new bays, giving an additional floor area of 19,650 sq. ft., have just been completed. Further extensive additions to plant and machinery will be completed within the next two months to cope with the increasing demand for "Qualcast" lawn mowers and light grey-iron castings for which this firm is so well known.

THE SHEFFIELD METALLURGICAL ASSOCIATION has elected Mr. G. Stanfield as its President for the ensuing year. Other officers elected are:—Vice-Presidents, Messrs. J. H. S. Dickenson, S. A. Main, H. Rollin and T. Swinden; hon. treasurer, Mr. H. H. L. Lockley; hon. librarian, Mr. R. Rowson; hon. secretary, Mr. W. H. Bailey; Council members: Messrs. S. J. Hewitt, A. J. Jack, T. H. Arnold, G. Glenn, P. B. Henshaw, C. W. Hirst, J. H. G. Monypenny, R. D. Pollard, H. W. Webster and J. Woolman.

AS A FURTHER DEVELOPMENT in the use of iron plates as road foundations by the Shotts Iron Company, Limited, the County Road Board has, on the recommendation of the surveyor, decided to experiment on two 20-yd. stretches of road on the Edinburgh highway at Holytown and also at Newhouse. The charge to be made by the company for the plates is 6s. per sq. yd., on the understanding that the cost of the plates will be refunded in the event of the experiment proving a failure and the road having to be taken up again.

AT A CONFERENCE in Belfast of representatives of the owners, builders, and underwriters, it was decided not to rebuild the 20,000-ton motor-liner "Bermuda," of the Furness-Withy Line, which was seriously damaged by fire at the wharf at Belfast, where she was being finished after partial reconstruction. The conclusion arrived at after an exhaustive survey was that it would cost more to rebuild the vessel than to construct a new ship. An order has already been given by the owners to Messrs. Vickers-Armstrongs, Limited, Barrow, for a new ship.

We regret to announce that neither the French nor the German report has been received up to the time of going to Press. These, however, will be concluded in a future issue.

Personal.

DR. HAROLD MOORE, Director of Metallurgical Research, War Office, has been made a C.B.E.

MR. JAMES MILNE, general manager of the Great Western Railway, has received a Knighthood.

MAJOR RICHARD MILES has been appointed a local director of Newton, Chambers & Company, Limited.

MR JAMES DENNY and Mr. Leslie Denny have retired from the board of Messrs. William Denny & Bros., Limited, Dumbarton.

MAJOR R. A. BULL, director of the (American) Electric Steel Founders' Research Group, has been elected a member of the Joint Research Committee on the Effect of Temperature on the Properties of Metals, sponsored by the A.S.T.M.

MR. GEORGE E. ALLIN, who was for many years works manager of Ley's Malleable Castings Company, Limited, Derby, and subsequently technical

MR. GEORGE E. ALLIN.

representative, has been appointed works manager of Messrs. Qualcast, Limited, Derby, and took up his new duties on January 1.

Wills.

ELLISON, FRANK, of Sheffield, steelworks manager £8,254

KNOWLES, J. J., a director of Messrs. John Knowles (Wednesbury), Limited, wrought-iron tube and fittings manufacturers £17,815

BROWN, PERCY, vice-chairman and joint managing director of Messrs. David Brown & Sons (Huddersfield), Limited, gear cutters and engineers... £157,376

Steel Furniture and Equipment.—One of the greatest changes during the last ten years or so has been the extraordinary development in the use of steel in the construction, equipment and furnishing of offices, banks and other large buildings. Messrs. G. A. Harvey & Company (London), Limited, Woolwich Road, London, who specialise in this class of work, point out the advantages of their steel doors and partitions. The latter are easily erected, and, being made in sections, they can be quickly dismantled and re-erected without skilled labour. Steel equipment is equally suitable for factories and warehouses, etc., and steel racks, bins, lockers and shelving serve a wide variety of uses with far greater efficiency than those of wood. Steel furniture and equipment, besides being far more durable than those of wood, are hygienic.

Obituary.

MR. C. E. MUMFORD, a member of the firm of A. G. Mumford, Limited, of Colchester, died last week at the age of 76.

WE REGRET TO ANNOUNCE the death of Sir William Mills, the inventor of the hand grenade bearing his name. Sir William was the founder of William Mills Atlas Aluminium Works, Grove Street, Birmingham, and William Mills (Sunderland), Limited, non-ferrous metal founders. He died at Weston-super-Mare on January 7, in his 76th year.

AS BRIEFLY ANNOUNCED last week, the death occurred suddenly of Mr. George M. Menzies, chairman and managing director of the North British Steel Foundry, Limited, Bathgate, whilst on a visit to Tweedsmuir, Peeblesshire. Mr. Menzies, who was in his 52nd year, started as an apprentice in the Bathgate branch of the Royal Bank of Scotland. Later he went to Dickson & Mann, Limited, iron and steel founders, Armadale, with which firm he ultimately became traveller, and later filled a similar position with Renton & Fisher, Limited, steel founders, Bathgate. When the North British Steel Foundry, Limited, was floated in 1907, Mr. Menzies was appointed managing director. The concern grew steadily, and at one time there were over 600 workmen employed; at the present time over 300 are employed. Mr. Menzies was the fourth director of the company to die within the past ten months. He was a member of the Bathgate Town Council for 16 years, and besides serving as a bailie he rendered valuable service as Convener of the Finance Committee. He held several other public posts, and was a generous supporter of every movement to advance the welfare of the town. Mr. Menzies is survived by a widow, three sons and two daughters.

Contracts Open.

Liverpool, January 21.—Iron and steel stores, for the Corporation. The General Manager, Liverpool Corporation Tramways, 24, Hatton Garden, Liverpool.

London, S.W.—Iron and steel stores, for the Army. The Director of Army Contracts, Caxton House (West), Tothill Street, Westminster, London, S.W.1.

Pietermaritzburg, February 4.—3,006 ft. of 3-in. and 1,998 ft. of 4-in. cast-iron pipes, etc., for the Corporation of Pietermaritzburg. The Department of Overseas Trade. (Reference G.X. 11,052.)

Singapore, March 14.—Sluice valves, for the Singapore Municipality Water Department. The Department of Overseas Trade. (Reference G.X. 11,045.)

Wellington, February 11.—Electrically-driven centrifugal pumping unit, etc., for the Wellington City Corporation. The Department of Overseas Trade. (Reference G.X. 11,043.)

Witham, January 29.—Five miles of cast-iron water main, 4 in. to 8 in. dia., and fittings, for the Witham Urban District Council. Messrs. Pick, Everard, Keay & Gimson, 6, Millstone Lane, Leicester. (Fee £2 2s., returnable.)

Woodford, Northants, January 22.—2½ miles of cast-iron water main, 4 in. to 3 in. dia., and fittings, for the Thrapston Rural District Council. Messrs. Pick, Everard, Keay & Gimson, 6, Millstone Lane, Leicester. (Fee £2 2s., returnable.)

MR. HORE-BELISHA, Parliamentary Secretary to the Board of Trade, resumed his investigation of conditions in the iron and steel trade last week when he visited Sheffield. On Monday he visited the Atlas Works of Messrs. Thos. Firth & John Brown, Limited, the Tinsley Works, where he witnessed the manufacture of stainless steel, and the Don Works of the English Steel Corporation, Limited. On Tuesday, Mr. Hore-Belisha went on to the Templeborough Works of the United Steel Companies, Limited, and later the East Hecla Works of Messrs. Hadfields, Limited. He was entertained at lunch at the Sheffield Club by representative people of the steel industry. In the afternoon a visit was paid to the Carlisle Works of Messrs. Kayser, Ellison & Company, Limited, and those of Messrs. Arthur Lee & Sons, Limited. On Wednesday morning Mr. Hore-Belisha visited Messrs. Joseph Rodgers & Sons, the cutlery manufacturers, after which he returned to London.

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FOR THE

IRON FOUNDRY

SO CLOSELY HAVE WE CONCENTRATED ON MOULDING SANDS TO SUIT EVERY NEED OF THE IRON FOUNDER, THAT WE CANNOT SPEAK OF THEM WITHOUT ENTHUSIASM.

We either own or control the sources of supply of the following prime favourites :

BRAMCOTE RED
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HENSALL (Y.A.P.)
HECK
SOUTH CAVE
PICKERING
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&c., &c.

Free samples and quotations on application.

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(REGISTERED)

THE UNIQUE SELF-SETTING FIRE CEMENT

We have always felt that in perfecting and introducing Pyrolyte, we did a service to the whole community of users of Refractories. Its users agree. Pyrolyte is a fire cement which without any heat being applied to it, dries as hard as stone ; just like Portland Cement does. Like the latter it is used for making a concrete. It is so refractory that we can say with confidence that there is no commercial heat it will not withstand.

You will agree that these are valuable and unique properties, won't you ?

In your works you have Portland Cement that will set hard and you have Fireclays and Silica Cements perhaps that will resist heat, but the Portland Cement will not STAND FIRE and the others will not set hard unless intense heat is applied to them. PYROLYTE WILL DO BOTH. Every works has a use for Pyrolyte. It is a Powder in a steel drum—

KEEP IT HANDY !

Further information gladly supplied by our Dept. P. which is in charge of Mr. E. F. Crawley.

OUR SILICA SANDS ARE BRITISH

SILICA SANDS

Whilst MODESTY is, and will, we trust, always continue to be, our distinguishing characteristic ; TRUTH compels us to say that in all Europe, there is no firm which has made such a study of Silica Sands as we have, or that has such resources for their supply of so great a variety.

Near King's Lynn we own our own freehold Sand Quarries and 30 acres of Sand-bearing land.

It will be a great pleasure for us to quote if you say what the sand is to be used for.

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Every Firebrick does not give satisfaction in a ladle, and it does not follow that a high priced first class firebrick gives the best results, or costs the least per ton.

We Have Solved This Problem and Shall be Glad to GIVE YOU THE BENEFIT

FIRECLAY BRICKS

We have a remarkable variety of Firebricks to offer.

Through our associated companies we can offer bricks from Stourbridge, Scotland, Derbyshire, Durham, Burton District, Sheffield and elsewhere.

Nobody can beat us for Price or Quality

and we know what will SUIT YOU.

To SCOTLAND!

FROM our Loudoun Mills in Ayrshire, neath the shadow of Loudoun Castle, (where the Treaty of Union with England was signed)—Loudoun, whose banks and braes have so oft been sung and whose snowdrops but yesterday enchanted the eye—we offer a complete service of Native Sands for the use of the Ironfounder and Steelfounder in Scotland.

ROCK SANDS mellow and plastic or coarse grained and siliceous.

MILLED SANDS of every degree of plasticity and bond.

SILICA SANDS coarse or fine and

KELLAMITE the improved material for Steel Foundry use.

'Phone our Glasgow Office : South 1580. (Mr. A. W. Montgomery).

U IN T

PLASSTICK

an adhesive refractory paste.

We have a rather remarkable material.

It has for long been known that the Fireclays overlying the Northampton ironstone possessed certain remarkable properties.

They dry with little or no shrinkage, they can be heated up with less swelling, spalling and cracking than most clays, and they stand heat remarkably well.

Above all they are extraordinarily plastic, and sticky, and they don't readily leave the object to which they have been made to adhere when wet.

HOWEVER

They vary in quality a lot, and they need careful preparation of the right kind.

After months of selection we have found the best of them. It is mixed and milled in the best way. The result is "PLASSTICK."

FOR CUPOLA LINING AND PATCHING, FOR LADLES, TAPPING HOLES, & BRICK SETTING.

T O

Raw Material Markets.

The opening of a new year has not meant any increased business in the iron and steel trades. It is true that a certain number of the usual stock-replenishment orders have been received, but these are mostly of small tonnage, the big consumers having already covered their requirements for the first quarter of the year.

The depression in the heavy engineering and shipbuilding industries continues to affect the steel trade, and it is difficult to keep the mills rolling regularly. Competition from the Continent remains severe.

Pig-Iron.

MIDDLESBROUGH.—Business in the Cleveland iron market has fallen short of expectations, and few new orders have been booked. There has, of course, been some replenishing of stocks, but not to the extent anticipated. The majority of consumers are not very ready to buy, in view of the present trade depression. Another unfavourable factor is that the accumulated holiday output of the furnaces has yet to be disposed of. However, there has been no change in prices, which remain as follow:—No. 3 Cleveland G.M.B., 58s. 6d.; No. 1 foundry, 61s.; No. 4 foundry, 57s. 6d.; No. 4 forge iron, 57s. per ton.

Orders are scarce in the East Coast hematite market. The makers' quotation for mixed numbers remains at 65s. per ton, with 6d. extra for No. 1, but this figure is understood to have been shaded by the merchants, some of whom are carrying large holdings. On the West Coast, however, business in hematite has shown an improvement, and there is a large volume of inquiries, many of which come from overseas. Orders placed are not of large tonnage, but should be sufficient to absorb the limited production.

LANCASHIRE.—Little new business has been transacted during the past week, but it is satisfactory to note that heavier contract deliveries of foundry iron have been requisitioned. A few new orders have been received for January-February delivery, but the total turnover has been small. Prices remain unchanged, with Midland foundry makes on offer for delivery to users in the Manchester price zone at 67s. per ton, North-East Coast at 67s., Northamptonshire at 65s. 6d., Derbyshire forge iron at 62s., Scottish pig-iron at about 87s. and West Coast hematite at 81s.

MIDLANDS.—Conditions remain quiet in this area, any new orders received being of small dimensions, as most of the big consumers are already covered for the first quarter of the year. Prices were reviewed at a recent meeting of the Central Pig-Iron Producers' Association, but no alteration was decided on. For delivery to Birmingham and Black Country stations, makers quote 62s. 6d. for Northants No. 3 and 66s. for Derbyshire, North Staffordshire and Lincolnshire No. 3.

SCOTLAND.—Some of the works have not yet resumed operations, and little business has been done in the pig-iron market. Quotations remain unaltered. Scottish No. 3 foundry iron remains at 69s. 6d. f.o.t. furnaces. Cleveland No. 3 is at 61s. 6d. at Grangemouth. It is reported that a parcel of Indian iron, mostly basic, is to arrive in the Clyde this month.

Coke.

The coke market in the Midlands remains unchanged. Best Durham coke continues at 37s. 6d. to 39s., with Welsh coke at 30s. to 37s. 6d., according to grade, delivered in the Birmingham district. In the Middlesbrough area, a good demand has developed and 17s. per ton, delivered works, is quoted for furnace coke.

Steel.

The finished-steel makers are finding business very quiet, the heavy engineering and shipbuilding industries being poor consumers. Some of the light engineering trades are busier, but there is much room for improvement, and only small parcels of bars are being sold. The outlook is not encouraging.

Scrap.

There is an improved tone in the Cleveland scrap iron and steel market, and prices are firm. A good quantity of heavy steel scrap has been bought at 40s. per ton and merchants are now inclined to ask 42s. 6d. The Midlands market is also showing some activity and prices are strongly held. Heavy machinery cast-iron scrap, in handy sizes, is at 52s. 6d. per ton, and clean light metal at 40s., delivered. The South Wales market is quiet and prices are easier. Business has not yet been fully resumed in Scotland, and quotations are nominally the same.

Metals.

Copper.—Consumers are showing little interest in the market, the majority being already covered, and Monday's rise in price may be attributed to reports of an agreement amongst producers as to the marketing of their output. The announced reduction of output to 26½ per cent. of capacity should go a long way towards reducing the present disparity between supply and demand. If the scheme is carried into effect, an increase in price may be looked for, since it is well known that, with copper selling at 7.25 cents and less, many of the mines have been producing at a loss.

Closing quotations :—

Cash.—Thursday, £39 7s. 6d. to £39 8s. 9d.; Friday, £39 2s. 6d. to £39 5s.; Monday, £41 2s. 6d. to £41 5s.; Tuesday, £42 15s. to £42 17s. 6d.; Wednesday, £42 2s. 6d. to £42 5s.

Three Months. — Thursday, £39 15s. to £39 16s. 3d.; Friday, £39 8s. 9d. to £39 10s.; Monday, £41 5s. to £41 7s. 6d.; Tuesday, £42 10s. to £42 12s. 6d.; Wednesday, £41 17s. 6d. to £42.

Tin.—Industrial consumption at home and abroad shows no improvement, except for the South Wales tinplate industry, which is securing more orders than for some time past. (The Elba Tinplate Works, employing 1,000 men, were restarted on Monday, after six months' idleness.) The market has recently received support from strong buying by non consumers.

Official closing prices :—

Cash.—Thursday, £140 7s. 6d. to £140 10s.; Friday, £141 2s. 6d. to £141 5s.; Monday, £142 12s. 6d. to £142 15s.; Tuesday, £142 12s. 6d. to £142 15s.; Wednesday, £142 2s. 6d. to £142 5s.

Three Months.—Thursday, £143 7s. 6d. to £143 10s.; Friday, £144 5s. to £144 7s. 6d.; Monday, £145 15s. to £145 17s. 6d.; Tuesday, £145 15s. to £145 17s. 6d.; Wednesday, £145 2s. 6d. to £145 5s.

Spelter.—Little demand is being experienced from consumers. The galvanised sheet industry is finding orders difficult to secure, particularly from India, where internal conditions have seriously affected trade. The price of spelter is largely supported by the fact that the International Zinc Cartel is undertaking such drastic measures for the curtailment of output.

Daily fluctuations :—

Ordinary.—Thursday, £14 11s. 3d.; Friday, £14 12s. 6d.; Monday, £14 13s. 9d.; Tuesday, £14 13s. 9d.; Wednesday, £14 11s. 3d.

Lead.—The lead market remains quiet, there being little buying during the stock-taking period. Messrs. James Forster & Company say that "Deliveries in London, owing to the Lightermen's strike, are being held up, but as consumers are well supplied with the metal and orders are few and far between, this is not so far causing any inconvenience." The latter statement emphasises the lack of any consumptive buying.

The week's prices have been :—

Soft Foreign (Prompt).—Thursday, £15 7s. 6d.; Friday, £15 6s. 3d.; Monday, £15 11s. 3d.; Tuesday, £15 12s. 6d.; Wednesday, £15 10s.

Strength of Steel at High Temperatures.

The Department of Scientific and Industrial Research (Engineering Research) has issued Special Report No. 17* on "The Strength at High Temperatures of a Cast and a Forged Steel as used for Turbine Construction," by MESSRS. H. J. TAPSELL and A. E. JOHNSON, which states that the investigation was undertaken in the engineering department of the National Physical Laboratory at the request of the British Electrical and Allied Industries Research Association as part of the general programme of work for the Committee of the Department of Scientific and Industrial Research appointed to supervise researches on the behaviour of materials at high temperatures.

The Report contains the results of short-time tensile tests and creep tests carried out on a 0.30 per cent. carbon cast steel and a 0.39 per cent. carbon forged steel over a temperature range of approximately 400 deg. C. to 650 deg. C. These steels were chosen as representative of those used in the construction of steam turbines. Full tensile properties and the stresses corresponding to rates of creep down to 10^{-4} in. per in. per day have been determined. The results are given in numerous tables and curves. These show that the cast steel possesses limiting-creep stresses of 10, 8 and 4 tons per sq. in. at 400 deg. C., 450 deg. C. and 497 deg. C. respectively, while the forged steel has the values 13, 10 and 5 tons/sq. in. at 400 deg. C., 447 deg. C. and 507 deg. C. respectively.

Alloy-Steel Castings.—During the session of the Open-Hearth Committee of the American Institute of Mining and Metallurgical Engineers, held at Detroit recently, one speaker stated that the rise in percentage of alloy castings to total castings was from 4.3 in 1917 to 13.9 in 1928. Since then there had been a drop of 11.4 per cent. in 1930, due partly to improved methods of making carbon steel and to greater knowledge regarding its heat-treatment.—"The Iron Age."

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CAST IRON FLANGED PIPES
2 in.–12 in. & CONNECTIONS. to 24 in. dia.
WE HAVE FIFTY-TWO YEARS OF ACCUMULATED EXPERIENCE AND METAL PATTERNS.
JAMES & RONALD RITCHIE, LTD.,
Telephone: 3852 (2 Lines). MIDDLESBROUGH. Telegrams: "Ritchie, Middlesbrough."

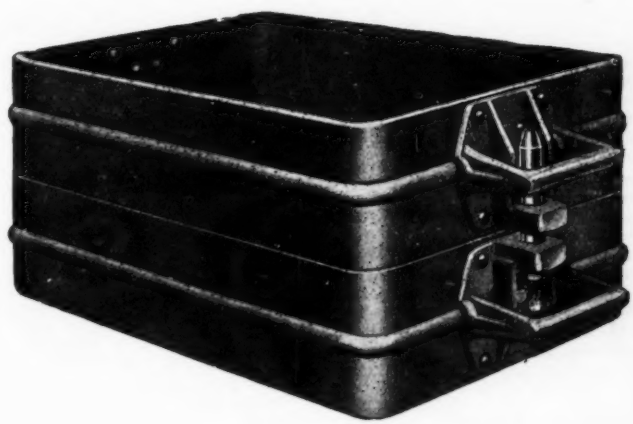
Service Sterling

SOLID RIBBED ROLLED STEEL
MOULDING BOXES

Whatever in the future may be the varying fortunes of Sterling Currency on the world's exchanges, foundrymen can rest assured there will be no fluctuation in the value of Sterling Moulding Boxes.

If you stick to Sterling Boxes your moulders will do more work and far better work with less effort; they will produce more accurate castings; you will save money on your fettling costs and more than halve your box maintenance costs—indeed there will be greater efficiency and economy all round. We stand by this statement and will gladly prove it.

Sterling moulding boxes are produced in England's largest Foundry Equipment Works and offer you the nearest approach to perfection that science and skill have yet achieved at a price no more expensive than for ordinary boxes.



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STERLING BOXES will help to make them
BETTER and CHEAPER

STERLING FOUNDRY SPECIALTIES LIMITED.

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WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash	42	2	6
Three months	41	17	6
Electrolytic	48	10	0
Tough	43	15	0
Best selected	44	0	0
Sheets	77	0	0
India	58	0	0
Wire bars	50	10	0
Do., February	50	10	0
Do., March	50	10	0
Ingot bars	50	10	0
H.C. wire rods	52	0	0
Off. av. cash, Dec.	38	6	5 5/12
Do., 3 mths., Dec.	38	19	1 5/12
Do., Sttlmnt., Dec.	38	6	3
Do., Electro, Dec.	45	14	1 1/12
Do., B.S., Dec.	40	6	9
Do., wire bars, Dec.	46	19	1 1/12
Solid drawn tubes			11½d.
Brazed tubes			11¼d.
Wire			7½d.

BRASS.

Solid drawn tubes	10d.
Brazed tubes	12d.
Rods, drawn	9d.
Rods, extd. or rlld.	5½d.
Sheets to 10 w.g.	8½d.
Wire	8½d.
Rolled metal	8d.
Yellow metal rods	5½d.
Do. 4 × 4 Squares	6¼d.
Do. 4 × 3 Sheets	6¼d.

TIN.

	£	s.	d.
Standard cash	142	2	6
Three months	145	2	6
English	144	0	0
Bars	146	5	0
Straits	145	7	6
Australian	143	17	6
Eastern	147	15	0
Banca (nom.)	162	12	6
Off. av. cash, Dec.	138	19	7 5/12
Do., 3 mths., Dec.	141	19	3 9/12
Do., Sttlmt., Dec.	138	19	6 1/12

SPELTER.

	£	s.	d.
Ordinary	14	11	3
Remelted	13	12	6
Hard	11	15	0
Electro 99.9	17	0	0
English	15	12	6
India	14	0	0
Zinc dust	23	0	0
Zinc ashes	4	0	0
Off. aver., Dec.	14	11	9 11/12
Aver. spot, Dec.	14	7	2 13/12

LEAD.

	£	s.	d.
Soft foreign ppt.	15	10	0
English	17	0	0
Off. average, Dec.	15	5	5 3/4
Average spot, Dec.	15	3	9

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	24	10	0
Do., V.M. ex-whf.	27	0	0
Rods	32	0	0
Boiler plates			—
Battery plates			—

ANTIMONY.

	£	s.	d.
Special brand, Eng.	40	0	0
Chinese	28	5	0
Crude	22	0	0

QUICKSILVER.

	£	s.	d.
Quicksilver	18	5	0

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—	
25%	—
45/50%	—
75%	—
Ferro-vanadium—	
35/50%	12/8 lb. Va.
Ferro-molybdenum—	
70/75% c. free, 4/2, plus 55% per lb. Mo.	
Ferro-titanium—	
23/25% carbon-free	11½d. lb.
Ferro-phosphorus, 20/25%	£21 0 0
Ferro-tungsten—	
80/85%	1/8½ lb. plus 20%
Tungsten metal powder—	
98/99%	1/11½ lb. plus 20%
Ferro-chrome—	
2/4% car.	£34 0 0
4/6% car.	£24 10 0
6/8% car.	£23 10 0
8/10% car.	£22 10 0
Ferro-chrome—	
Max. 2% car.	£36 10 0
Max. 1% car.	£41 10 0
Max. 0.70% car.	£51 0 0
70% carbon-free	11d. lb.
Nickel—99% (nom.)	£245 to £250
Ferro-cobalt	8/6 lb.
Aluminium 98/99%	£95 0 0
Metallic chromium—	
96/98%	3/- lb.
Ferro-manganese (net)—	
76/80% loose	£10 15 0 to £11 5 0
76/80% packed	£11 15 0 to £12 5 0
76/80% export	(nom.) £ 9 0 0
Metallic manganese—	
94/96% carbon-free	1/6 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten	2s. 0d.
Finished bars, 18% tungsten	2s. 9d.

Per lb. net, d/d buyers' works.

Extras—	
Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to 5/16 in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅛ in.	3d. lb.
Do., under ¼ in. × ¼ in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.
Bars cut to length, 10% extra.	

SCRAP.

	£	s.	d.	£	s.	d.
South Wales—						
Heavy steel	2	6	6 to	2	7	6
Bundled steel and shrngs.	1	14	0 to	1	15	0
Mixed iron and steel	2	0	0 to	2	2	0
Heavy cast iron	2	7	0 to	2	8	0
Good machinery for foundries	2	12	0 to	2	14	0
Cleveland—						
Heavy steel	2	0	0 to	2	2	6
Steel turnings				1	12	6
Cast-iron borings				1	6	0
Heavy forge				3	0	0
W.I. piling scrap				2	12	6
Cast-iron scrap	2	5	6 to	2	7	6
Midlands—						
Light cast-iron scrap				2	0	0
Heavy wrought iron				2	12	6
Steel turnings, f.o.r.				1	3	0
Scotland—						
Heavy steel				2	2	6
Ordinary cast iron				2	7	6
Engineers' turnings				1	10	0
Cast-iron borings				1	12	6
Wrought-iron piling				2	7	0
Heavy machinery				2	15	0

London—Merchants' buying prices delivered yard.

	£	s.	d.
Copper (clean)	30	0	0
Brass	22	0	0
Lead (less usual draft)	12	10	0
Tea lead	9	10	0
Zinc	7	0	0
New aluminium cuttings	62	0	0
Braziery copper	27	0	0
Gunmetal	26	0	0
Hollow pewter	90	0	0
Shaped black pewter	70	0	0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast—	
Foundry No. 1	61/-
Foundry No. 3	58/6
Foundry No. 4	57/6
Forge No. 4	57/-
Hematite No. 1	65/6
Hematite M/Nos.	65/-
N.W. Coast—	
Hem. M/Nos. d/d Glas.	73/-
,, d/d Birm.	84/6
Malleable iron d/d Birm.	117/6
Midlands—	
Staffs common*	—
,, No. 4 forge*	61/-
,, No. 3 fdry.*	66/-
Shrops basic	—
,, Cold blast, ord.	—
,, ,, roll iron	—
Northants forge*	57/6
,, fdry. No. 3*	62/6
,, fdry. No. 1*	65/6
Derbyshire forge*	61/-
,, fdry. No. 3*	66/-
,, fdry. No. 1*	69/-
,, basic*	—

*d/d Black Country dist.

Scotland—	
Foundry No. 1	72/-
,, No. 3	69/6
Hem. M/Nos. d/d	68/6
Sheffield (d/d district)—	
Derby forge	58/6
,, fdry. No. 3	63/6
Lincs forge	—
,, fdry. No. 3	63/6
E.C. hematite	76/-
W.C. hematite	83/6
Lancashire (d/d eq. Man.)—	
Derby forge	62/-
,, fdry. No. 3	67/-
Staffs fdry. No. 3	67/-
Northants fdry. No. 3	65/6
Cleveland fdry. No. 3	67/-
Dalzell, No. 3 (special)	102/6 to 105/-
Glengarnock, No. 3	87/-
Clyde, No. 3	87/-
Monkland, No. 3	87/-
Summerlee, No. 3	87/-
Eglinton, No. 3	87/-
Gartsherrie, No. 3	87/-
Shotts, No. 3	87/-

FINISHED IRON AND STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£	s.	d.	£	s.	d.
Bars (cr.)	9	15	0 to	10	0	0
Nut and bolt iron	8	7	6 to	8	10	0
Hoops	10	10	0 to	12	0	0
Marked bars (Staffs) f.o.t.				12	0	0
Gas strip	10	10	0 to	12	0	0
Bolts and nuts, ¾ in. × 4 in.	12	10	0			
Steel—						
Plates, ship, etc.	8	15	0 to	8	17	6
Boiler plts.	8	15	0 to	9	15	0
Chequer plts.				10	7	6
Angles				8	7	6
Tees				9	7	6
Joists				8	15	0
Rounds and squares, 3 in. to 5½ in.				9	7	6
Rounds under 3 in. to ⅜ in. (Untested)	6	15	0 & up.			
Flats—8 in. wide and over	8	12	6			
,, under 8 in. and over 5 in.	8	17	6			
Rails, heavy	8	5	0 to	8	10	0
Fishplates				12	0	0
Hoops (Staffs)				9	10	0
Black sheets, 24g.	8	0	0 to	9	0	0
Galv. cor. shts.	9	0	0 to	9	5	0
Galv. flat sheets	9	10	0 to	9	15	0
Galv. fencing wire, 8g. plain				—		
Billets, soft	5	7	6 to	5	12	6
Billets, hard				6	12	6
Sheet bars	5	0	0 to	5	5	0
Tin bars				5	0	0

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	11½d.
Sheet to 10 w.g.	12½d.
Wire	13½d.
Rods	11½d.
Tubes	17d.
Castings	13d.

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1½ to 1/7½
To 15 in. wide	1/1½ to 1/7½
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2½ to 1/8½
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3½
Ingots rolled to spoon size	10d. to 1/6½
Wire round—	
to 10g.	1/4½ to 1/11½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3½ upwards.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	15.51
No. 2 foundry, Valley	15.50
No. 2 foundry, Birm.	12.00
Basic	16.76
Bessemer	17.76
Malleable	17.76
Grey forge	17.31
Ferro-mang. 80%	75.00
O.-h. rails, h'y, at mill	43.00
Billets	28.00
Sheet bars	28.00
Wire rods	37.00
	Cents.
Iron bars, Phila.	2.09
Steel bars	1.50
Tank plates	1.50
Beams, etc.	1.50
Skelp, grooved steel	1.50
Skelp, sheared steel	1.50
Steel hoops	1.65
Sheets, black, No. 24	2.25
Sheets, galv., No. 24	2.80
Wire nails	1.95
Plain wire	2.20
Barbed wire, galv.	2.60
Tinplates, 100-lb. box	$4.75

COKE (at ovens).

Welsh foundry	22/6 to 25/-
,, furnace	17/6 to 18/-
Durham and Northumberland—	
,, foundry	14/6 to 15/-
,, furnace	14/6
Midlands, foundry	—
,, furnace	—

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 per box	14/- to 14/6
,,	28×20 ,,	28/- to 29/-
,,	20×10 ,,	—
,,	18¾×14 ,,	—
C.W.	20×14 ,,	12/9 to 13/-
,,	28×20 ,,	25/3
,,	20×10 ,,	19/4½
,,	18¾×14 ,,	13/9

SWEDISH CHARCOAL IRON & STEEL.

Pig-iron	£6	0	0 to	£7	0	0
Bars, hammered, basis	£16	10	0 to	£17	0	0
Bars and nail-rods, rolled, basis	£15	17	6 to	£18	5	0
Blooms	£10	0	0 to	£12	0	0
Keg steel	£32	0	0 to	£33	0	0
Faggot steel	£18	0	0 to	£23	0	0
Bars and rods dead soft, st'l	£10	0	0 to	£12	0	0

All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr. 18.16 to £1.]

TUBES AND FITTINGS.

Current Discounts.

	Tubes.	*Fittings.*
Gas	62½%	57½%
Water	58½%	52½%
Steam	55%	47½%

W.I. 12½% extra.

DAILY FLUCTUATIONS.

Standard Copper (cash).

	£	s.	d.		
Jan. 7	39	7	6	inc.	15/-
„ 8	39	2	6	dec.	5/-
„ 11	41	2	6	inc.	40/-
„ 12	42	15	0	„	32/6
„ 13	42	2	6	dec.	12/6

Electrolytic Copper

	£	s.	d.		
Jan. 7	47	0	0	inc.	30/-
„ 8	47	0	0	No change	
„ 11	47	10	0	inc.	10/-
„ 12	49	0	0	„	30/-
„ 13	48	10	0	dec.	10/-

Standard Tin (cash).

	£	s.	d.		
Jan. 7	140	7	6	inc.	57/6
„ 8	141	2	6	„	15/-
„ 11	142	12	6	„	30/-
„ 12	142	12	6	No change	
„ 13	142	2	6	dec.	10/-

Tin (English ingots).

	£	s.	d.		
Jan. 7	142	0	0	inc.	55/-
„ 8	142	15	0	„	15/-
„ 11	144	5	0	„	30/-
„ 12	144	5	0	No change	
„ 13	144	0	0	dec.	5/-

Zinc Sheets (English).

	£	s.	d.		
Jan. 7	24	10	0	No change	
„ 8	24	10	0	„	„
„ 11	24	10	0	„	„
„ 12	24	10	0	„	„
„ 13	24	10	0	„	„

Spelter (ordinary).

	£	s.	d.		
Jan. 7	14	11	3	inc.	3/9
„ 8	14	12	6	„	1/3
„ 11	14	13	9	„	1/3
„ 12	14	13	9	No change	
„ 13	14	11	3	dec.	2/6

Lead (English).

	£	s.	d.		
Jan. 7	16	15	0	inc.	5/-
„ 8	16	15	0	No change	
„ 11	17	0	0	inc.	5/-
„ 12	17	0	0	No change	
„ 13	17	0	0	„	„

Imports and Exports of Iron Castings in December and the twelve months 1931, compared with December and the twelve months 1930.

	December, 1930.	December, 1931.	Twelve months, 1930.	Twelve months, 1931.	December, 1930.	December, 1931.	Twelve months, 1930.	Twelve months, 1931.
Imports.	Tons.	Tons.	Tons.	Tons.	£	£	£	£
Pipes and Fittings, Cast	1,254	1,105	21,038	13,742	14,713	15,739	244,601	183,051
Castings, in the Rough, Iron	234	88	2,374	1,405	4,725	2,017	50,258	28,277
„ „ „ Steel	539	609	12,414	6,471	13,396	11,206	298,528	130,105
Hollow-ware, Cast, not Enamelled	8	2	45	78	600	110	4,383	5,447
„ „ Enamelled	1	—	31	50	65	63	1,877	2,851
Exports.								
BUILDERS' CASTINGS—								
To Argentine Republic	133	33	1,810	833	6,720	1,353	81,634	39,499
„ British South Africa	235	208	2,591	2,422	8,233	5,963	99,879	85,098
„ „ India	102	76	1,536	1,295	3,872	3,244	56,285	47,778
„ Australia	9	5	262	73	303	160	14,979	3,668
„ New Zealand	66	28	988	358	4,329	2,132	58,633	22,174
Total (including other countries)	1,458	1,222	17,852	13,972	71,300	53,137	796,865	620,457
PIPES AND FITTINGS—CAST—								
To Argentine Republic	1,250	370	15,184	5,305	12,994	2,727	151,033	50,625
„ British South Africa	456	1,332	10,268	8,224	5,187	12,077	110,193	92,314
„ „ India	83	79	2,792	1,662	2,048	1,697	42,805	27,076
„ Straits Settlements and Malay States	134	164	10,679	2,721	1,601	1,756	92,933	29,643
„ Ceylon	50	21	1,421	741	734	244	15,204	8,669
„ Australia	21	422	769	587	434	4,327	14,348	8,094
Total (including other countries)	5,709	7,093	116,279	72,776	73,748	64,026	1,293,331	804,930
HOLLOW-WARE—								
Cast, not Enamelled, and Cast, Tinned	281	239	3,972	2,262	10,512	8,370	131,770	79,655
„ Enamelled	71	77	832	587	5,774	6,205	71,339	55,379
CASTINGS, in the rough—								
Iron	108	111	2,277	2,341	3,620	3,398	69,202	58,842
Steel	221	29	2,093	1,093	4,590	1,089	83,043	39,388

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13, RUMFORD STREET, LIVERPOOL.

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All grades FOUNDRY, HEMATITE, BASIC, SPECIALS, &c.

NON-FERROUS METALS

COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

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SITUATIONS WANTED.

MOULDER, 22 years in the trade, requires job; experienced in crucible and stainless steels, engineering and ornamental work. Modern methods; go anywhere.—G. A. INCLES, 62, St. Lawrence Road, Tinsley, Sheffield.

YOUNG Man (29), 14 years' practical moulding experience, malleable and grey irons, holding City and Guilds Certificate for Metallurgy, seeks progressive position. Keen, energetic, ambitious.—Box 972, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

YOUNG TRAVELLER seeks post with foundry; 5 years' practical experience; salary, expenses and commission. Any offer will receive his immediate attention; please write.—C. BROWN, 63, First Avenue, Enfield.

PARTNERSHIP.

PRACTICAL Foundryman desires to purchase Partnership in small country jobbing foundry.—Send full details to Box 968, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

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AGENTS OR LICENSEES required for most modern core ovens, stoves, annealing furnaces, to be manufactured in England to my designs.—Apply to DIPL.-ING. NEUSTÄDTER, Hagen (Westphalia), Germany.

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Will Sell whole or in lots to suit customers or Let on favourable terms. Unique opportunity for Manufacturers.

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THOS. W. WARD, LTD.,
ALBION WORKS, SHEFFIELD.

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SAND MIXERS.—New and Secondhand. Ask us to quote.—W. BREALEY & COMPANY, LIMITED, Station Works, Ecclesfield, Sheffield.

WANTED, Pneumatic Press Moulding Machine, for snapflask work.—Box 970, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

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BONVILLAIN & RONCERAY Universal Roll-over MOULDING MACHINE, hydraulic squeeze, type R.C.1, complete with Down Sand Frame Equipment.
Maximum available height under ram, 3 ft. 6 in.
Dimensions of table, 4 ft. 11 in. x 3 ft. 10½ in.
Distance between columns, 3 ft. 10½ in.
Stroke of ramming piston, 1 ft. 4 1/16 in.
Pressure required for operation, 750 lbs. per sq. in.

The machine is complete with vertical type accumulator complete with all necessary valves, couplings, piping, etc., to make a self-contained unit of plant. The complete plant is in excellent condition and has been very little used. It was installed in 1927 and cost, ex maker's works and exclusive of installation expenses, £963.

OFFERS ARE INVITED.

"Adaptable" MOULDING MACHINE, No. 1802, to take 17 x 15 boxes. £20.

"Denby" JOLT MOULDING MACHINE, hand-operated, 24-in. square plate. £25.

One CUPOLA, 19 ft. high x 2 ft. 6 in. dia., to deliver 3 tons of metal per hr., complete with 90 new furnace bricks, and complete with "Cyclone" fan. £50.

"Adaptable" Portable Electric RIDDLE, 18½ in. dia., with ⅓-h.p. motor, 220 volts D.C. £12 10s.

Several Geared LADLES, 30-cwt., 20-cwt. and 8-cwt. capacity. Offers invited.

Portable Beam Type PLATFORM SCALE, to weigh up to 2½ cwts. Offers invited.

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FOR SALE, as new, cheap. Tilghman's Sand Blast Plant. Type V.I. Complete, suitable for ordinary requirements. Vertical Tilghman's Compressor. Air Receiver and Exhausting Fan and Accessories.—OUZLEDALE FOUNDRY COMPANY, Barnoldswick.

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Pneumatic Sand Moulding Machine, admits pattern boxes 16 in. x 16 in. x 6 in.

Geared Foundry Ladles, with carriers, each 3 ft. 7 in. dia. at top, 3 ft. dia. at bottom x 3 ft. 9½ in. deep.

No. 6 Empire Pressure Blower, capacity 120 cub. ft. per min.

Leimann Patent High-Pressure Blower, Size E, capacity 58 cub. ft. per min.

4-wheel 10-in., 12-in. and 14-in. LOCOMOTIVES, ready for immediate work and despatch, for Sale or Hire.

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ALBION WORKS, SHEFFIELD.

MISCELLANEOUS.

CUT DOWN COSTS 25 per cent. by using S.M. Patent Heating Coke; graded to meet all requirements.—Inquiries to STANDARD MINERALS COMPANY, Dept. 11, Bilbie Street, Nottingham.

MISCELLANEOUS—*Continued*

WAX CORE VENTS, British make, all sizes, executed from stock. Also Foundry Plumbago, various grades. — WILLIAM OLSEN, LIMITED, Cogan Street, Hull.

250 TONS of good Cast Scrap Iron, free from burnt, for Sale. What offers? —H. J. GASSON & SONS, Government Contractors, Rye. 'Phone, Rye 34.

'Phone: 287 SLOUGH

LADLES—GEARED

12-Ton "Stevenson"	... ...	£48
9-Ton "MacNeil"	... ...	£42
6-Ton "Thwaites"	... ...	£34
4-Ton "Evans"	... ...	£28
2-Ton "Evans"	... ...	£19

SAND PLANT

3 ft. 6 in. "Evans" Sandmill		£15
"Jackman" SM4 Aerator	...	£12
"Herbert" sand whizzer	...	£32
"Jackman" Rotary Sifter	...	£8

BUY FROM ME AND SAVE MONEY!

ALEX. HAMMOND, *Foundry Machinery Merchant,*
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DEGASIFIED REFINED PIG IRON

The original and exclusive Bradley Degasification treatment of Refined Pig Irons has resulted in the production of Super-refined Pig Irons of a quality hitherto unknown. Completely homogeneous, close-grained and easily machined, Bradley's Degasified Refined Pig Irons are specially suitable for locomotive cylinders and all classes of high-duty castings. The Bradley Degasification process is essentially a mechanical one, and consists of the introduction into the receiver holding the molten iron, of a number of stirring paddles which are rotated at speed, thus setting up a movement in the metal of considerable velocity. The fact that this plant has been in regular operation for over a year and a-half, treating substantial quantities of cylinder pig iron for high duty work, is some evidence of the value of the treatment and of the satisfactory results obtained by users of these super-quality irons. Messrs. Bradley & Foster Ltd., of Darlaston, Staffs, the original makers of Degasified Refined Pig Irons, will be pleased to supply full particulars of these irons on application.

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